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INLAND TRANSIT.

THE

PRACTICABILITY, UTILITY, AND BENEFIT

OF

RAILROADS;

THE COMPARATIVE ATTRACTION AND SPEED

OF

Steam Engines,

ON

A RAILROAD, NAVIGATION, AND TURNPIKE ROAD;

REPORT

OF A SELECT COMMITTEE OF THE HOUSE OF COMMONS ON

STEAM CARRIAGES,

WITH AN ABSTRACT OF THE EVIDENCE TAKEN BEFORE PARLIAMENT ON THE BIRMINGHAM RAILROAD BILL; WITH THE PREAMBLE;

ALSO,

THE PLANS, SECTIONS, AND ESTIMATES

OF THE

PROJECTED GRAND SOUTHERN AND NORTHERN RAILROADS.

By N. W. CUNDY, Civil Engineer.

Second Edition.

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TO

THE LANDOWNERS, CULTIVATORS,

MANUFACTURERS, MERCHANTS, AND BANKERS

OF

Great Britain.

My Lords and Gentlemen,

The march of science and the mind of man have opened new lights in the field of domestic improvements. The construction of Railroads is a new era in our history; and the beneficial effects already produced by all the Railroads established, give sufficient guarantee for their extension.

I venture to submit to your consideration the expanded advantages that would emanate from the establishment of five railroads from the metropolis; viz.— a *Northern*, *Eastern*,

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Southern, *Western*, and *Midland*. These Railroads would connect the great agricultural, grazing, and manufacturing districts, with a proximity to trade, like a single community.

These Railroads would extend agriculture and manual labour, and send forth the produce of the soil, the loom, and the factory, to the best markets, at a third of the former expence, and by giving cheapness extend consumption, to the benefit of all.

I respectfully lay the following pages before you, pointing out some of the advantages and effects of Railroads and Steam transits, for your perusal and kind indulgence.

I have the honour to be,
My Lords and Gentlemen,
Your devoted and faithful servant,

N. W. CUNDY.

London, *December*, 1833.

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INLAND TRANSIT.

The usefulness of railroads is now admitted by all classes of the people; and the beneficial results have been apparent to the landowner, cultivator, and trader, wherever they have been established. The construction of railroads, like other things, requires experience, practice, and reflection. The railroads that have been constructed, have not been executed upon the best model or form that might have been adopted, although designed by engineers of great talent, taste, and powers of mind; and nothing but practical experience could have shown the results now obtained. The Manchester and Liverpool railroad, in my opinion, is constructed too narrow both in the trams and the space between them, and the sharp curvations in that road should be avoided, if possible, as well as the sedant inclined planes: the level on the line should be divided as equal as possible in the distance.

The curvation produces considerable friction on the flanches of the wheels, which impedes the velocity of the carriage, as well as the uphill, and strains the action of the machinery, and causes a considerable additional consumption of fuel by the delay.

The Darlington and Stockton railway is about forty miles in length, and has been in work eight years. It was first constructed in a single tram or line of rails; but the directors soon found that a single line of road was not sufficient to transport their increasing trade. They have lately added double

trams or lines of road, with a number of inlets and outlets on each side of the line, by which they have now avoided all obstructions.

I would respectfully call the attention of the reader and the public to the reports and evidence of the directors of the above railroads, given in evidence on the London and Birmingham Railroad Bill, in the last session of Parliament, which will be found herein, with the estimates of expense, revenue, and proceedings on that interesting and important incorporation, as well as the advantages of the Liverpool and Manchester railroad; also the Darlington and Stockton, with their respective expense, revenue, and benefit.

There are seven other railroads now projected; viz. 1st, the London, and Birmingham, and Liverpool, called the Midland railway; 2d, the London and Greenwich, which has been since designed to Dover, now called the Eastern railway; 3d, the London and Southampton railway; 4th, the London, Bath, and Bristol, called the Great Western railway; 5th, the London and Brighton railway; 6th, the Grand Southern railway, from London to Horsham, Arundel, Portsmouth, and Southampton, and from Horsham to Shoreham and Brighton; 7th, the Grand Northern railway, from London to York, with several branches to Norwich, Nottingham, Sheffield, Leeds, Hull, &c.

There are two or three other projects in contemplation; a branch from the Western to the town of Windsor, and another in Leicestershire.

1st, — The London and Birmingham Railroad Company was incorporated in the last session of Parliament. This design, will, no doubt, prove a great national benefit; it will give extensive and lasting advantages to the landowners, farmers, graziers,

manufacturers, mineralogists, and merchants in the midland counties, and the metropolis.

This line of country is not very favourable for such a work: the distance on the line from London to Birmingham is 112 *miles*, and Birmingham is situated about 365 *feet* above London, and the highest summit on the line is 418 *feet*, at Tring, 30 miles from London.

The greatest rise is about 16 feet per mile, in several parts of the line. The railroad will be constructed with 10 *tunnels*. The first tunnel will be 2 miles from London; the second at Harrow Weald, 13½ miles; the third at Watford; the fourth near Tring, 30 miles; the fifth at Leighton Buzzard; the sixth, seventh, and eighth, at Weedon; the ninth at Kilsby; and the tenth at Berkswell, — making together about 8 miles of tunnel on this line;

Width of railway on embankments -		28 feet.
Viz. — Double lines of rails, each line being five feet wide - - -	10	
Space between the two lines -	6	
Space outside the lines, 6 feet on each side - - -	12	
	28	
Width on the cuttings - -	30	

One foot additional being allowed on each side for a drain.

This line of railroad may be considered perfectly practicable; but, owing to the general rise and fall of the country, as appears by the section of the projected railroad, with 10 tunnels, must necessarily be expensive in its construction and maintenance in repairs, lighting the tunnels, and attendants; although I believe that Messrs. Stephenson, the engineers, have selected the best line of country between London and Birmingham for the design.

Unless they had taken the line by Oxford, Tame, and thence between Warwick and Stratford-upon-Avon, to Birmingham. This line may be two or three miles longer in point of distance, but would avoid the tunneling, and a better level and under strata would be found; as well as the traffic in coaching, &c. from the West of England, Cheltenham, Gloucester, Worcester, Kidderminster, Tewkesbury, Stratford, Warwick, and Oxford, at a considerable less expense.

The estimated expense is 2,205,352*l.*, and the annual revenue, when completed, is 793,407*l.* This may appear, to some, a considerable outlay of capital; but I respectfully submit, that it will prove one of the most beneficial designs *ever projected* in England. It opens a grand, safe, and expeditious line of transit through the midland country, by which science, manual labour, agriculture, manufactures and commerce, will be extended beyond the power of man to contemplate, and a flood of prosperity will return, hitherto unknown to civilised man.

2d.—The London and Greenwich Railway Company was incorporated by act of Parliament, on the 17th May, 1833. Distance of this line is about $3\frac{3}{4}$ miles on a tide level; estimated expense is 400,000*l.*; the annual revenue about 105,550*l.*; and the expense of conducting, wear and tear, &c. of the railroad, is 23,550*l.* per year. It may be considered that the London and Greenwich railway is only the commencement of the Great Eastern railway to Dover. This design is novel; it is proposed to be constructed upon arches about twenty feet high, from London Bridge to Greenwich, on a tide level the whole of the way; designed by George Landman, Esq. the engineer, who has laboured hard with Mr. Walters, the secretary, whose conduct deserves public thanks. The engineer, no doubt, has reflected well upon the cause

and effect of his design: the design upon arches must be considered a very considerable additional expense, and this estimate cannot be taken as an average expense of railroad; the average expense of railroads is within 8000*l.* to 10,000*l.* per mile on the level. This line of railroad is intended to pass His Majesty's arsenal at Woolwich, and from thence to Gravesend, and to cross the river Medway below Chatham, and thence to Dover, with a branch by Eltham to the vale of the Medway, to Tunbridge and Maidstone, which can be constructed without a tunnel. I feel confident that the line over the river Medway below Chatham is objectionable, inasmuch as the Government will not consent to a bridge being thrown across that river below Chatham. The line by Eltham, Riverhead, Maidstone, to Dover, is about seventy-nine miles in distance, and a much better line of country, and will prove a lasting benefit to the landowners, cultivators, farmers, and hop-growers of Kent: it will enable them and travellers to execute their respective interests, without any delay, at one half of their former expenses.

3d.—The railroad is designed by Francis Giles, Esq., civil engineer, from London to Southampton. Distance of this line is within eighty miles; and the engineer's estimate expense, 1,000,000*l.*; and the probable revenue is estimated, when completed, at 374,451*l.* 8*s.* 6*d.* per annum; and the annual expense of repairs for conducting the railroad at 56,000*l.* The line is from Lambeth, and to pass by Kingston, Weybridge, Basingstoke, and Winchester, to Southampton; the levels of that line of country are not favourable for a railroad; the summit level is 380 feet above London. This inclined plane rises *twenty-two feet per mile*, for about eleven miles on the line. I consider

that *Mr. Giles* has selected the best line between London and Basingstoke; and is exceedingly wise in not recommending a tunnel through the long summit between Basingstoke and Winchester, of nineteen miles; and the line appears to me, without a tunnel, impracticable. According to the law of railroads, as will be found in theory and practice, *no* railroad for despatch of business, speed, and safety, should rise more than from twelve to fourteen feet per mile. The law of gravity, propulsion, and speed, will be found to be obstructed about *one hour* in every two feet rise, in twenty miles; so that the speed of a steam engine that could perform thirty miles an hour on the level, will be reduced to less than five miles per hour, upon a rise of twenty feet per mile. And the Great Western Railway is proposed to pass almost parallel with the Southampton, from London to Basingstoke, Reading, and Newbury, would reduce the estimated traffic on the Southampton line considerably. And it appears, by the estimate of traffic, that the revenue chiefly depends upon the coach trade on the line to Basingstoke. Southampton is a beautiful town, and a place more for fashion than trade, and this line can never be made a line of despatch or speed, owing to the rapid rise and fall of the country; consequently, the Southampton railroad cannot be considered a national object.

The 4th railroad in progression is the Grand Western Line, between London, Bath, and Bristol; the line of distance is about 122 miles. This line of country is very favourable for a railway, about sixty miles on the line from London. This great national work is projected by Mr. J. E. Brunel, who is the engineer to the company, and who has investigated that line of country; and I feel no doubt, from Mr. Brunel's activity and talent, that he has selected the best line

for the purpose that can be found. But the hilly country for twenty miles to the east of Bath, which is from 700 to 1000 feet high above the level of Bath, forms almost an insurmountable barrier to a railroad.

Mr. Brunel proposes a tunnel through those hills whose under strata is composed of chalk and freestone of easy and safe cutting. But there are decided objections to tunneling for railroads at the depth and length here required. First, the tunnel must be many miles long, without light and air, except artificial air and light, perhaps gas lights. The want of atmospheric air, combined with the combustion of gas, smoke, and steam, will render the tunnel almost incapable of human existence. And, secondly, the condensed or compressed air in the tunnel, if it is only a mile long, will give a formidable resistance to the speed of the propelling engine and train of carriages, that would require more than double the power to propel them, compared with the power on the same level in the open air; and if a carriage enter at the other end at the same time, it will act like two balls in a tube*, the one would repel the other. Thirdly, in driving a tunnel, of the presumed depth of only 600 or 700 *feet* below the surface of that country, is considerably below the level of several great springs, that form the head of the rivers Isis, the Kennet, and the Avon; and cutting across the country by the projected tunnel would, no doubt, tap these powerful springs, which would drain all the high country, and convert the projected tunnel into a river.

The line from Bath to Bristol is about twelve miles

* I am aware that air shafts may be made, and that tunnels can be arched, in clay or sandy under strata at a great expense.

in length, and may be considered almost tide level; and that part of the design may be easily executed, at a moderate expense. Both stone and iron, in abundance, is at hand; two of the chief materials for constructing railroads. This work, if executed, would confer a lasting benefit on the country. The engineer's estimated expense is 2,550,300*l.*, and revenue about 747,752*l.* 11*s.*

5th.—There are two projected lines from London to Brighton and Shoreham. The first line from London, Croydon, Mersham, St. Leonard's, to Shoreham and Brighton, is about fifty-four miles on the line of distance projected by Mr. Vingnolds, civil engineer, and designed to commence from the Elephant and Castle, Newington, and to run from thence to Norwood and Croydon, Merstham and St. Leonard's Forest, to Shoreham and Brighton. In the above line, Mr. Vingnolds has designed two tunnels; the first tunnel is intended to pass under the Beulah Spa, from Norwood to Croydon, about two miles and a half. The summit at Croydon will be 170 feet above the tide at London Bridge, and will rise from Croydon, about twenty feet per mile, to Merstham summit. Merstham summit will be 360 feet above the tide; and another tunnel to pass into the vale of the Mole, thence by the County Oak, to St. Breval's and St. Leonard's Forest and Bramber, to Shoreham and Brighton. There are three decided objections in constructing a railroad on this line: *first*, a railroad could be carried from London to Croydon, by Tooting and Mitcham Commons, on an easy inclined plane, without a tunnel; *secondly*, a tunnel under the Beulah Spa will drain away all the water in that district, and the same will happen at Merstham; and, *thirdly*, the high elevation of the two summits at Merstham and St. Breval's Forest, with the rapid falls

on the line, would render a railroad useless, as to speed and carriage of heavy loads, with very considerable extra cutting on the line.

The second line is from London to Brighton and Shoreham, projected by Messrs. Rennie, civil engineers, to commence at Kensington Common, and run from thence to Tooting and Mitcham Commons, to Carshalton; thence between Merstham and Reigate, by Horley, and Crawley, and Hand Cross, to Brighton; and from Brighton to Shoreham. The summit of this line *is about* 500 *feet* above the tide at London Bridge. Distance on the line about fifty miles to Brighton, and six to Shoreham, making together fifty-six miles. The first ten miles is an excellent progressive level, and firm ground; but the *rise and fall* of that line of country from Carshalton to Brighton appear to be impracticable for the construction of a railroad, for travelling or the carrying of goods, or any other useful purpose, which I understand Messrs. Rennie purpose to obviate, by constructing four tunnels under the four high summits, on their projected line, *to save distance*, and the passing over hills from 700 to 800 feet high; by their section, the length of tunnels together will be about ten miles on the line to be cut throughout, an under strata of chalk, freestone, loam, clay, sandstone, and gravel, in some places, 200 to 300 feet below the surface of the country, besides considerable extra cutting on the line, and the enormous expense of the tunnels.

The tunneling would, no doubt, tap the Great Surrey and Sussex springs, which rise above the level of the projected tunnels, which springs form the heads of the rivers Mole, Wey, Arran, Adur, Medway, and Derwent. All these rivers take their course near, or immediately in the line of the projected railway; and it is more than probable that by tapping these

springs, the line of railway would become converted into a river to Brighton, and that the uplands would be drained of their waters, by tapping the springs below.

These waters pass through veins in the earth, both on high ground and low levels, like the construction of the veins in the human body; and all practical men know, that if a vein or artery is opened in the foot, it will let out all the blood in the head; and if there were no other reason, the tunneling for so long a distance, with the obstruction of the air in the tunnel, and the combustion of gas, steam, smoke, and sulphur, renders, in my opinion, this design impracticable. The expense is estimated at 850,000*l.*, and the revenue about 130,000*l. per annum.* It also appears by the law of gravity and propelling power of a movable steam engine, the rise, and long progressive inclined planes here designed, no travelling engine would exceed the speed of the present Brighton coaches; and questionable, from the experiments made on the Manchester and Liverpool railroad, that an engine, with travelling machinery, could be constructed to go up hill, twenty-five feet per mile, at the speed of five miles an hour, as I shall hereafter refer to the respective experiments tried on a railroad, and the comparative speed on the level, the progressive rise, or up hill and down hill, with its several effects, loads, delays, and advantages.

I feel no doubt but Messrs. Rennie have, long since, reflected upon all the above consequences; but I, with great respect, venture, for the public good, to differ in opinion with them on the line and construction of their projected railway; and more particularly so, *when they know* that there is a line of country about the same distance with practicable levels, and that a railroad can be constructed from London, to Shoreham

and Brighton, without a tunnel. *They have* given notice to Parliament, and Parliament will investigate the merits of all the above projects.

6th,—Is the Grand Southern railway, projected by myself. I now consider that the science of constructing railroads with the aid of locomotive engines, has already outstripped both the speed and national utility of canals; and having the knowledge of the line of country between London and Portsmouth and Brighton, from my former surveys in the *grand ship canal* to Portsmouth, I, in September, announced my intention to lay a plan before the public, of a railroad between London and Horsham and Portsmouth, with a branch from Horsham, to Shoreham and Brighton; finding that line of country, from its levels, well calculated for a railroad, there being but two summits over which the line would have to pass, at Epsom Common, 150 feet, and the other on the Holm Wood, 200 feet above the tide at London Bridge, and on this line no tunneling would be required; see plan and section. The utility of this design is too apparent to require a long comment, and would avoid the objections of the two other projected lines, both as to tunnels, levels, and draining the upland country of all its water; while it would give to the landowner, trader, traveller, merchant, and Government, the advantages of proximity of the whole southern coast, to the metropolis, in time of war or peace, by the speed and safety of a well-constructed railroad, without delay or danger. My estimate of this great work is about 1,500,000*l.* and revenue about 500,000*l. per annum when completed.*

As this work is of great national importance, I have not thought it right to press the subject now,

but shall wait another session of Parliament, with all its details, &c. &c.

7th. *Grand Northern Railroad from London to York and Leeds, with Branches to Norwich, Nottingham, Sheffield, and Hull.* (*See Plan and Section*).

With the view of accomplishing this desirable object, the direct line of country has been surveyed, and found so favourable, that but little extra cutting would be required, about 150 miles of the distance (which is within 190 miles) being nearly tide level.

It is proposed to commence the projected railroad at Kingsland, near Shoreditch, and to run thence by Tottenham and Waltham to Bishop's Stortford (with short branches to Hertford and Ware), to proceed from Bishop's Stortford by Saffron Walden and Linton to Cambridge, Peterborough, Stamford, Grantham, Newark, Lincoln, Gainsborough, and Snaith, meeting the Leeds railroad at Selby, and thence to York, with a branch from Cambridge by Newmarket, Bury, and Thetford to Norwich, distant about sixty miles.

This work, when accomplished, will immediately give to the great northern agricultural and manufacturing counties all the advantages of proximity to the metropolis, by the speedy transit of a railroad.

The advantages of railroads were proved in the last session of Parliament by a great number of landowners, cultivators, manufacturers, and merchants. They were found to have conferred the highest benefit on the public, more particularly to those on the line, land having increased in value from 30 to 50 per cent. wherever railroads have been established; in addition to which, it appeared to be a fact, that the proprietors of the Liverpool and the Darlington

railroads had already shared from 15 to 20 per cent. upon their extensive outlay and experiments, and that their business has been increasing every week.

It cannot admit of doubt that great advantage would accrue to landowners, cultivators, breeders, and dealers in grain, cattle, &c. in the countries through which this railroad would pass, by the facility they would find in transmitting their timber, coals, stone, iron, lime, bricks, grain, hay, straw, flour, cattle, sheep, calves, pigs, butter, butcher's meat, and all other landed produce to the London markets, at the rate of 20 miles an hour, without loss or damage, and at a third of the former expense.

This railroad will prove of incalculable advantage to the manufacturers of Norwich, Bury, Peterborough, Ely, Stamford, Nottingham, Newark, Lincoln, Sheffield, Barnsley, Wakefield, Bradford, Leeds, Hull, and Glasgow, and the other northern districts, by enabling them to send their goods by a rapid transit to the metropolis at a small expense, and receive by back carriage the raw materials necessary for their respective trades.

By official returns, it appears that about one half of the home produce of grain, flour, malt, cattle, sheep, calves, pigs, meat, poultry, and butter sent to the London markets, arrives from the counties of Hertford, Essex, Cambridge, Suffolk, Norfolk, Huntingdon, Northampton, Rutland, Lincoln, Nottingham and York; and that the average number of sheep travelling this road weekly exceeds 11,000, with other live stock in proportion; besides which, woollen and other piece goods, Sheffield hardware, and other manufactures, are to be taken into account.

The proposed railway will also considerably benefit the London merchants, brewers, distillers, hop factors,

corn factors, mealmen, tea dealers, grocers, drapers, publishers, and all other traders, who return in exchange to these districts, containing a population exceeding three millions and a half of people, articles in their particular lines of equal consumption to the metropolis.

It can be proved also, that the coach traffic alone, between London and York, and the intermediate line of country, amounts to about per annum - - -	£550,500
That the carriage by vans and waggons may be taken at half that amount, without including posting and carriage of mails, troops, and military stores -	275,250
The inland trade from the ports of Hull, Boston, Holbeach, Spalding, Wisbeach, Lynn, Lowestoffe, Yarmouth, and other northern ports, and shipments of perishable goods, detained by contrary winds, viz. fish, butter, cheese, meats, tallow, hemp, flax, corn, &c. are estimated per annum at - - - -	150,000
The carriage of the landed produce and stock to the London markets, as above described, would exceed per annum -	200,000
The general merchandise passing to and from the above extensive manufacturing district in the north and the metropolis	150,000
Making together an annual revenue of	£1,325,750
The estimated annual expense of conducting the railroad when completed is -	160,000
Interest on four millions of capital -	200,000
Making together an annual expense of	£360,000

The engineer considers the line of country peculiarly favourable for constructing a railroad, both in its levels and the materials that are found on or near the line: he is decidedly of opinion that a railroad can be made at less expense on this than on any other line of country in England of the same distance.

In conclusion, it is submitted that the revenue of the projected railroad, when completed, will far exceed the above estimate. No notice has been taken of the great increase in coach traffic produced by the railway, nor of the intermediate travelling from town to town, and the districts to the north of York, Glasgow, and Edinburgh. Nor should it be forgotten, that long prior to the completion of the outline, the traffic on the first fifty miles could not fail to secure a revenue of 150,000*l.* per annum, within eighteen months of its commencement.

A detailed Estimate of the Expense of the proposed Railroad, viz.

2000 acres of land, at per acre 100*l.*	£200,000	£460,000
Houses, buildings, and compensation	260,000	
Bridges, culverts, drains, and masonry		450,000
Extra cutting, &c.		160,000
Blocks and sleepers, &c.		160,000
Ironwork for rails, bolts, pins, &c.		350,000
Ballasting and laying, ditto		160,000
Excavating, ditching, and fencing, &c.		400,000
12 water stations	£5,000	61,800
12 intermediate pumps	800	
50 engines complete	4,000	
400 waggons, vans, and trucks	12,000	
80 coaches complete	20,000	
Sheds, benches, and buildings	20,000	
Branch from Cambridge to Norwich		800,000
Contingencies on the above works		350,000
Total expense		£3,437,000

Proposed capital 4,000,000*l.*, in 80,000 shares of 50*l.* each.

Enterprise, capital, and skill have, of late years, been directed with extraordinary energy to the improvement of inland transport, and this important instrument of national wealth and civilisation has received a proportionate impulse. Effects are now witnessed, which, had they been narrated a few years since, could only have been admitted into the pages of fiction, or volumes of romance. Who could have credited the possibility of a ponderous engine of iron, loaded with several hundred passengers and goods, in a train of carriages of corresponding magnitude, and a large quantity of water and coal, taking flight from Manchester, and arriving at Liverpool, a distance of above thirty miles, in little more than an hour? And yet this is a matter of daily and almost hourly occurrence. Neither is the road on which this wondrous performance is effected the most favourable which could be constructed for such machines. It is subject to undulations and incurvations, which reduce the average rate of speed much more than similar inequalities affect the average rate on common roads. The speed of transport thus attained, is not less wonderful than the weights which this power is capable of transporting. Its capabilities in this respect far transcend the exigencies even of the two greatest commercial marts in Great Britain. Loads, varying from fifty to seventy tons, are transported at the average rate of fifteen miles an hour; but the engines would appear to be in this case loaded below their power; and in a recent instance, a load — I should rather say a *cargo* — of waggons, conveying merchandise to the amount of 230 tons gross, transported from Liverpool to Manchester, at the average rate of twelve miles an hour.

The astonishment with which such performances

must be viewed might be somewhat qualified, if the art of transport by steam on railways had been matured, and had attained that full state of perfection, which such an art is always capable of receiving from long experience, aided by great scientific knowledge, and the unbounded application of capital. But such is not the present case. The art of constructing locomotive engines, so far from having attained a state of maturity, has not even emerged from its infancy. So complete was the ignorance of its powers which prevailed even among engineers, previous to the opening of the Liverpool railway, that the transport of heavy goods was regarded as the chief object of the undertaking, and its principal source of revenue. The incredible speed of transport, effected even in the very first experiments in 1830, burst upon the public, and on the scientific world, with all the effect of a new and unlooked-for phenomenon. On the unfortunate occasion which deprived this country of Mr. Huskisson, the wounded body of that statesman was transported a distance of about fifteen miles in twenty-five minutes, being at the rate of thirty-six miles an hour. The revenue of the road arising from passengers since its opening, has, contrary to all that was foreseen, been nearly double that which has been derived from merchandise. So great was the want of experience in the construction of engines, that the company was at first ignorant, whether they should adopt large steam-engines, fixed at different stations on the line, to pull the carriages from station to station, or travelling engines, to drag the loads the entire distance. Having decided on the latter, they have, even to the present moment, laboured under the disadvantage of the want of that knowledge which experience

alone can give. The engines have been constantly varied in their weight and proportions, in their magnitude and form, as the experience of each successive month has indicated. As defects became manifest they were remedied; improvements suggested were adopted; and each quarter produced engines of such increased power and efficiency, that their predecessors were abandoned, not because they were worn out, but because they had been outstripped in the rapid march of improvement. Add to this, that only one species of travelling engine has been effectively tried; the capabilities of others remain still to be developed; and even that form of engine which has received the advantage of a course of experiments on so grand a scale to carry it towards perfection, is far short of this point, and still has defects, many of which it is obvious time and experience will remove. If, then, travelling steam-engines, with all the imperfections of an incipient invention — with the want of experience, the great parent of practical improvements — with the want of the common advantage of the full application of the skill and capital of the country — subjected to but one great experiment, and that experiment limited to one form of engine, and conducted, as I shall presently show, not on the wisest principles, nor with the most liberal policy; — if, under such disadvantages, the effects to which I have referred have been produced, what may we not expect from this extraordinary power, when the enterprise of the country is unfettered, — when greater fields of experiments are opened, — when time, ingenuity, and capital, have removed the existing imperfections, and have brought to light new and more powerful principles? This is not mere speculation on possibilities, but refers to what is in a state of

actual progression. Railways are in progress between the points of great intercourse in the United Kingdoms, and travelling steam-engines are in preparation in every quarter for the common turnpike roads; the practicability and utility of that application of the steam-engine, having not only been established by experiment to the satisfaction of their projectors, but proved before the legislature so conclusively, as to be taken for the foundation of Parliamentary enactments, and upon which large capital may be safely invested.

The important commercial and political effects attending such increased facility and speed in the transport of persons and goods, which were proved before Parliament in the sessions of 1831, 1832, and 1833, are too obvious to require any very extended notice here. A part of the price (and in many cases a considerable part) of every article of necessity or luxury, consists of the cost of transporting it from the producer to the consumer; and, consequently, every abatement or saving in this cost, must produce a corresponding reduction in the price of every article transported; that is to say, of every thing which is necessary for the subsistence of the poor, or for the enjoyment of the rich, of every comfort, and of every luxury of life. The benefit of this will extend, not to the consumer only, but to the producer: by lowering the expense of transport of the produce, whether of the soil or of the loom, a less quantity of that produce will be spent in bringing the remainder to market, and, consequently, a greater surplus will reward the labour of the producer. The benefit of this will be felt even more by the agriculturist than by the manufacturer; because the proportional cost of transport of the produce of the

soil is greater than that of manufactures. If 200 quarters of corn be necessary to raise 400, and 100 more be required to bring the 400 to market, then the net surplus will be 100. But if by the use of steam-carriages the same quantity can be brought to market with an expenditure of 50 quarters, then the net surplus will be increased from 100 to 150 quarters profit; and either the profit of the farmer, or the rent of the landlord, must be increased by the same amount; the same applies to cattle, &c.

But the agriculturist would not merely be benefited by an increased return from the soil already under cultivation. Any reduction in the cost of transporting the produce to market would call into cultivation tracts of inferior fertility, and uncultivated land, the returns from which would not at present repay the cost of cultivation and transport of manure. Thus land would become productive which is now waste, and an effect would be produced equivalent to adding so much fertile soil to the present extent of the country. It is well known that land of a given degree of fertility will yield increased produce by the increased application of capital manure and labour. By a reduction in the cost of transport, a saving will be made which may enable the agriculturist to apply to tracts already under cultivation the capital thus saved, and thereby increase their actual production. Not only, therefore, would such an effect be attended with an increased extent of cultivated land, but also with an increased degree of cultivation in that which is already productive; and manual labour would be extended, and the poor and county rates reduced.

It has been said that in Great Britain there are above a million of horses engaged in various ways in the transport of passengers and goods, and that to

support each horse requires as much land as would upon an average support eight men. If this quantity of animal power were displaced by steam-engines, and the means of transport drawn from the bowels of the earth, instead of being raised upon its surface, then, supposing the above calculation correct, as much land would become available for the support of human beings as would suffice for an additional population of eight millions ; or, what amounts to the same, would increase the means of support of the present population by about one third of the present available means. The land which now supports horses for transport on turnpike roads would then support men, or produce corn for food, and the horses return to agricultural pursuits.

The objection that a quantity of land exists in the country capable of supporting horses alone, and that such land would be thrown out of cultivation, scarcely deserves notice here. The existence of any considerable quantity of such land is extremely doubtful. What is the soil which will feed a horse, and not feed oxen, cows, or sheep, or produce food for man ? But even if it be admitted that there exists in the country a small portion of such land, that portion cannot exceed, nor indeed equal, what would be sufficient for the number of horses which must after all continue to be employed for the purposes of husbandry, pleasure, and in a variety of cases where steam must necessarily be inapplicable. It is to be remembered, also, that the displacing of horses in one extensive occupation, by diminishing their price, must necessarily increase the demand for them in others.

The reduction in the cost of transport of manufactured articles, by lowering their price in the market, will stimulate their consumption. This observation

applies, of course, not only to the consumer at home, but to foreign markets. In the latter, we already, in many branches of manufacture, command a monopoly. The reduced price which we shall attain by cheapness and facility of transport will still further extend and increase our advantages. The necessary consequence will be an increased demand for manufacturing population; and this increased population again reacting on the agricultural interests, will form an increased market for that species of agricultural produce. So interwoven and complicated are the fibres which form the texture of the highly civilised and artificial community in which we live, that an effect produced on any one point, is instantly transmitted to the most remote and apparently unconnected parts of the system.

The two advantages of increased cheapness and speed, besides extending the amount of existing traffic, call into existence new objects of commercial intercourse. For the same reason that the reduced cost of transport, as I have shown, calls new soils into cultivation, it also calls into existence new markets for manufactured and agricultural produce. The great speed of transit, which has been proved to be practicable, must open a commerce between distant points in various articles, the nature of which does not permit them to be preserved so as to be fit for use beyond a certain time. Such are, for example, many species of vegetable and animal food, which, at present, are confined to markets at a very limited distance from the grower or feeder. The truth of this observation is manifested by the effects which have followed the intercourse by steam on the Irish Channel. The western towns of England have become markets for a prodigious quantity of Irish produce, which it had been previously impossible to export. If animal

food be transported alive from the grower to the consumer, the distance of the market is limited by the power of the animal to travel, and the cost of its support on the road. It is only particular species of cattle which bear to be carried to market on common roads and by horse carriages. But the peculiar nature of a railway, the magnitude and weight of the loads which may be transported on it, and the prodigious speed which may be attained, render the transport of cattle, meat or fish of every species, to almost any distance, both easy and cheap. In process of time, when the railway system becomes extended, the metropolis and populous towns will therefore become markets, not, as at present, to districts within limited distances of them, but to the whole country within 200 miles of the metropolis.

The moral and political consequences of so great a change in the powers of transition of persons and intelligence from place to place, are not easily calculated. The concentration of mind and exertion which a great metropolis always exhibits, will be extended in a considerable degree to the whole realm. The same effect will be produced as if all distances were lessened in the proportion in which the speed and cheapness of transit are increased. Towns, at present removed some stages from the metropolis, will become its suburbs; others, now at a day's journey, will be removed to its immediate vicinity; business will be carried on with as much ease between them and the metropolis, as it is now between distant points of the metropolis itself. The ordinary habitations of various classes of citizens engaged in active business in the towns, will be at what now are regarded considerable distances from the places of their occupation. The salubrity of cities will thus be in-

creased, by superseding the necessity of heaping the inhabitants together, story upon story, within a confined space; and by enabling the town population to spread itself over a larger extent of surface, without incurring the inconvenience of distance. Let those who discard speculations like these as wild and improbable, recur to the state of public opinion, at no very remote period, on the subject of steam navigation. Within the memory of persons who have not yet passed the meridian of life, the possibility of traversing by the steam-engine the channels and seas that surround and intersect these islands, was regarded as the dream of enthusiasts. Nautical men and men of science rejected such speculations with equal incredulity, and with little less than scorn for the understanding of those who could for a moment entertain them. Yet we have witnessed steam-engines traversing, not these channels and seas alone, but sweeping the face of the waters round every coast in Europe, and even ploughing the great oceans of the world. If steam be not used as the only means of connecting the most distant habitable points of our planet, it is not because it is inadequate to the accomplishment of that end, but because local and accidental causes limit the supply of that material from which at the present moment it derives its powers. But that power is at this moment being accomplished: a steam packet of 1000 tons burthen is now building at New York, to be propelled by an engine of 260 horse power, with double paddles, designed as a passage vessel between New York and Liverpool, and to carry 1000 passengers every trip, a distance of about 3500 miles across the Atlantic, in twelve days, without regard to wind, weather, or tides, at the rate of fifteen miles an hour, this may be considered a floating island.

I propose, in the present article, to lay before you some account of the means whereby the effects above referred to have been produced; of the manner and degree in which the public have availed themselves of these means; and of the improvements of which they seem to me to be susceptible.

In considering the means of inland transport, there are two distinct points to which I should solicit attention, viz. the *road*, and the *power of traction or impulsion*. A road is a contrivance by which the resistance opposed to a body moving on the surface of the earth, arising from the inequalities of that surface, may be diminished; and as it diminishes that resistance, in the same proportion does it accomplish its object. The power of traction or impulsion is efficient in proportion to its intensity, and the rate at which it is capable of exerting that intensity in reference to time. On the *intensity* of the power depends the resistance it can overcome, and this intensity is therefore proportional to the *load*. On the *rate* at which this power can be produced and exerted, depends the *speed* which is attainable by it.

The roads most commonly used are those of water, or *canals;* those of stone, or *turnpike roads;* and those of iron, or *railroads*. In all these species of roads, the first and most necessary quality is, that the line should be as nearly as possible level. As this, however, cannot be perfectly attained, there are contrivances peculiar to each kind of road, by which the difficulty attending the want of perfect level may be overcome. But as such contrivances constitute the greatest expense, whether in the original construction of the road, or in working upon it after it has been constructed, that course should always

be selected for the line which offers the fewest possible inequalities, and those the smallest in amount.

Canals possess advantages over all other roads, in being able to support an almost unlimited amount of load. The pressure on the wheels of carriages on a railroad is limited by the strength of the rail, and is seldom more than about three tons upon each wheel. The pressure on the wheels of carriages on a turnpike road is limited by the strength of the crust of the road. On the broad wheels of the heaviest waggons the pressure never exceeds two tons; but the weight capable of being sustained by a canal is only limited by the magnitude of the boats which the breadth of the canal allows to float upon it. In fact, the weight of the boat and its cargo is equal to the weight of the water which is displaced by the part of the boat immersed in the canal.

In considering the power of traction or impulsion necessary to move a body, whether on a canal or on a road, I must carefully distinguish that force which is requisite to put the body from a state of rest into a state of motion, from that which is requisite to sustain the motion when once imparted to it. If a body were sustained by a surface perfectly level and perfectly smooth, so as to oppose no resistance whatever to motion upon it, without friction, the body once put in motion by an impulse would continue to move for a considerable time, without the application of any further impulsion or traction. But such a surface as is here supposed has no practical existence: although, as already explained, it is the object of roads of every kind to approach as near to this imaginary limit as possible.

The continual power of traction necessary to sustain the motion of a body, therefore, arises from the re-

sistance produced by the action of the body on the road; and it is only by investigating the nature of this resistance, and its law, that the necessary qualities in the drawing or impelling power can be fully understood. As the presence of resistance on the road does not supersede the necessity of the first impulse, it follows that every mass which is to be moved, requires a much greater exertion of power at starting than subsequently; but, as this exertion is continued only for a short period, I may omit its consideration, when that purpose is to investigate the power necessary to keep it in constant action.

The power of traction necessary to sustain the progressive motion of a boat floating on a liquid arises from the resistance of the liquid lying immediately before the boat. It is necessary that the vessel should divide the fluid which lies in its way; and the force necessary to move this with the speed of the vessel must be supplied by the power of traction or impulsion, whatever that power may be. It will be sufficiently obvious, on consideration, that the quantity of liquid which is thus driven or divided before the vessel, depends, not on the whole magnitude of the vessel, but on the magnitude of the transverse section of that part of the vessel which is beneath the surface of the liquid. It is true that this conclusion requires some modification in practice, and that the shape of the vessel and other circumstances should be taken into account, in accurate calculations; but the resistance mainly depends, as above stated, on the transverse section, and may be considered, *cæteris paribus*, proportional to that section. Now, the more rapidly the vessel is moved, the more rapidly the liquid must be removed before it, and, therefore, the greater the force necessary to impel it in this manner; and

hence a double speed requires that the liquid should be impelled with almost a double force. But besides this, it is to be considered, that when the vessel acquires a double speed, it moves in the same time through a double space, and therefore must impel *a double quantity* of the liquid. Since, therefore, it impels a *double quantity*, and every portion of that with almost *a double force*, the resistance which it has to overcome must be increased in a threefold proportion. Hence we see, that to give a vessel moving in a liquid a double velocity, requires that the power of traction or impulsion should be increased in a threefold proportion. In the same manner, it will be easily made out, even by the general reader, that a threefold velocity will require about sixfold power of traction or impulsion, and so on; the resistance and the necessary power of traction increasing not merely in the proportion of the speed, but in the proportion of what arithmeticians call the *square* of the speed.

Even this statement must be received in a qualified form, and limited in its application to moderate rates of motion; because it is demonstrable, that there is a practical limit of speed, beyond which a vessel cannot be impelled through a fluid, and that limit is by no means a wide one. Notwithstanding the application of the immense power of steam to vessels plying between points of great intercourse, I believe that a greater speed than from ten to twelve miles an hour has never yet been attained independently of the effect of currents.

To the power of impelling a vessel through water we see, therefore, that there is a narrow limit; but if this limit be narrow as applied to vessels in the open sea, it is still more so when applied to vessels in confined channels, such as canals. In this case the

theoretical reasoning above given would require great modification; and the resistance, which in practice is in every case greater than in the proportion of the square of the velocity, is considerably above that proportion in the case of canals. Experiments have been made by Mr. Bevan on the resistance to vessels moved at different speeds in water, and we find by them that a vessel moved on the Paddington Grand Junction Canal, at the rate of $2\frac{1}{2}$ miles an hour, loaded with 21 tons, required a force of traction amounting to 77 lbs.; while the same vessel moved at the rate of something less than 4 miles an hour, required a force of traction amounting to 308 lbs. Thus, while the speed was increased in a somewhat less proportion than $2\frac{1}{2}$ to 4, the resistance was increased in the proportion of $2\frac{1}{2}$ to 10. Experiments made by Mr. Walker on the London Docks give the resistance also in a greater proportion than that of the square of the velocity. Many other facts confirm this conclusion; but a singular anomaly appears to have been presented by some experiments made on the Forth and Clyde Canal in July, 1830. A twin-boat, loaded with 5 tons, 16 cwt. 44 lbs., and dragged by horses, was furnished with an instrument by which the force of traction was measured, and it was found, that at and under eight miles an hour, the resistance was in conformity with the principle just explained, but that when higher rates of speed were attained, although the resistance increased, it did not increase in nearly so rapid a proportion. This arose from the circumstance of the boat-speed having been more raised or less draft in the water by the effect of traction on the bank at the high speed. But be this as it may, the deviation from the law takes place in such extreme cases, and

under such peculiar circumstances, that no general conclusion can be safely drawn from it. I can venture to affirm, that a similar result would not be found to attend the propulsion of a boat by a steam-engine acting on paddle-wheels.

From what has been stated, it appears that the resistance to the motion of a vessel in a liquid does not increase in proportion with the weight of the vessel and its cargo. Two vessels of equal transverse section, but different lengths, may have very different weights, and yet suffer nearly equal resistance from the liquid in which they are moved. This forms a very important circumstance favourable to transport by canals, as compared with transport on other roads. On roads, the resistance is always in proportion to the weight; and by combining this circumstance with what has been already explained respecting the dependence of the resistance on the velocity, it will be easily perceived, that the most advantageous mode in which canals can be used is in the transport of very great weights at a very low speed. Indeed, independently of the limit of speed imposed by the law of resistance, there are other circumstances connected with canals which render any considerable rate of motion inapplicable to them; and one of the principal of these is, the wear and even destruction of the embankments, which would be produced by the rapid flow of water caused by boats propelled through them at any rapid rate of motion; although I am of opinion that a light steam boat can be propelled with more speed on a canal than on the sea, with equal force. But when a carriage is drawn or impelled along a hard and level road, the motion which it receives from the first impulse would continue undiminished for a short

time, if the road and the faces of the wheels were perfectly smooth, and no resistance of the air. This is a consequence of one of the first and most simple properties of matter, — *inertia;* that property in virtue of which a body would remain for ever at rest, if not put into a state of motion by the action of some external force. But the formation of a perfectly smooth road, and of perfectly smooth wheels to move on that road, is impracticable in this country. The surface of the road and the surface of the wheels, whatever is their materials, or with whatever care they may be constructed, will be covered with asperities; which will obstruct the motion of the carriage in proportion to their number and magnitude, and in proportion to the weight with which the carriage presses upon them. The more these asperities are removed, therefore, the less will be the force of traction necessary to continue the motion of a carriage loaded with a given weight. Experiments made on an extensive scale by Coulomb, Ximenes, and other philosophers, have established satisfactorily, that, when the quality of the road and of the wheels are the same, the resistance of the motion of the carriage, arising from the roughness of the road, will always be in proportion to the weight of the carriage. A double weight will offer double resistance, a triple weight a triple resistance, and so on. The same experiments establish another consequence, materially affecting all questions respecting the work performed on roads. This result is, that the *resistance to the motion of a carriage is altogether independent of the velocity* of that motion; and that, whatever be the speed at which the carriage moves, the resistance will suffer no change. Indeed, any slight change

which may have been indicated, rather shows a diminution of resistance with increased speed; but for practical purposes the resistance may be regarded as constant, and quite independent of the velocity. I therefore infer, that the power of traction necessary on level roads, whether they be roads of stone or roads of iron, will always be in proportion to the load, and independent of the speed.

This becomes one of the most striking features of difference between the effects in favour of roads and against canals. In the latter, every increase of speed renders a proportionate increased power of traction necessary; while in the former no increased power of traction whatever is needed. If a carriage be propelled on a road ten miles in five hours, or ten miles in one hour, the power of traction must be precisely the same in both cases; but if a boat be propelled on a canal ten miles in one hour, the power of traction must be more than ten times that which would be necessary to carry it ten miles in five hours. This observation will be equally applicable to turnpike roads and railroads, as compared with canals; and it will lead to the inference that there is a limiting speed, at which the effect of canals must equal the effect of a hard level road travelled by a carriage; and that below this limit the canal has the advantage, while, above it, the advantage lies with the road. As the resistance to the boat in the water has an immediate dependence on its rate of motion, it follows, that by reducing that rate of motion without limit, the resistance may be also reduced in a proportionate limit; while, on the other hand, the resistance to a carriage moving on a railroad, being independent of the speed, the reduction of speed can cause no dimi-

nution in the resistance. It is therefore possible to assign such a velocity to a boat moved on a canal, that the resistance will exactly equal the resistance of the road to the carriage loaded with a weight equal to that of the boat.

Now, as the resistance of a canal below this limit will be less, while the resistance of the road will remain the same, it follows that at lower velocities the canal, *cæteris paribus*, will present less resistance to the force of traction. On the other hand, by increasing the speed beyond the limit assigned, the resistance of the canal increases faster than the square of the velocity, while the resistance of the road suffers no increase whatever. Hence, above this limit, the road will possess considerable advantage over a canal.

But besides this, the resistance of the road to the carriage increases in the direct proportion of the weight of the load; while the resistance of a canal to the boat is, comparatively speaking, but slightly increased by an increase of the weight. From these circumstances it is easy to infer, that very great weights, moved at very low velocities, require a less power of traction on canals than on common roads. But, on the other hand, when the speed is increased, or when the load is more moderate in its amount, the advantage of a common road prevails, and more especially with reference to the increase of speed. The greatest speed at which canals can be advantageously worked is from two to two and a half miles an hour. Now, we shall see hereafter, that when adequate moving powers are applied, even with very considerable weights, the speed attainable, without loss of advantage on roads, bears a large proportion to this.

Railroads are contrivances for obtaining a surface for the wheels of carriages to roll upon, smoother than the surface of a turnpike road, whether Macadamised or paved. To accomplish this, bars of iron are constructed of a suitable length, and laid upon the road, so that they present upwards a smooth surface; their extremities resting upon large blocks of stone firmly imbedded in the earth, called *sleepers*. These iron bars, which are called *rails*, are firmly connected end to end, and extend from sleeper to sleeper along the whole line of road, so as to form one continuous smooth track or line of iron surface, upon which the wheels of the carriage roll. Two parallel tracks of these bars are placed at a distance, corresponding to that of the width of the wheels of the carriage intended to run upon them. The wheels are constructed with a ledge of iron projecting at right angles to the faces of their tires, which as they roll catches the inner surface of the rail, so as to prevent the carriage from slipping off at either side. There are several forms of rails in use, some have a saddle edge to receive the vec of the wheel.

When the surfaces of the tire and the rail are clean, the resistance which they present is extremely small, owing to the hardness of the material of which they are composed, and the smoothness of which its surface is susceptible. Two parallel tracks of rails upon which the wheels of the same carriage roll are called "a single line of railway." In order to enable carriages on such a line moving in contrary directions to pass one another, retiring places called *sideings* are provided at certain intervals, into which a carriage may be turned, so that one may wait till another passes. This provision is indispensable where

the points of intercourse are connected only by a single line; but, in cases of great intercourse, two lines are sometimes provided for carriages moving in opposite directions, in which the delay produced by carriages meeting in opposite directions is avoided.

The power of traction required on a well-constructed level railway is generally estimated at the 240th part of the load drawn. The smallness of this proportion gives rise to a consequence of great practical importance when inclined planes occur; as must always be the case at points where the level of the country road changes. In addition to the ordinary resistance of the rails, the power of traction in ascending must overcome the tendency of the load to descend by its gravity. This tendency, as is well known, bears a proportion to the load equivalent to the elevation of the plane. If the plane rise 1 foot in 100, the tendency of a load of 100 tons to descend will be 1 ton. Upon this principle, if the plane rise 1 foot in 240, the power of traction, compared with that which is necessary upon a level, will be double. An ascent of 2 feet in 240, or 1 in 120, will require a three-fold power of traction; an ascent of 3 feet in 240, or 1 in 80, will require a four-fold power of traction, and so on. Hence it is obvious how enormously the drawing power must be increased even by the slightest incurvation. An ascent of 1 in 240, or 17 feet in 1400 yards, which requires the power of traction to double its energy, is scarcely perceptible to the eye; and the rise of 1 in 96 at Rainhill, on the Manchester line, which is barely perceivable, requires the power of traction to increase its intensity in nearly a four-fold proportion. It follows, therefore, that whatever agent may be employed as a propelling power on a railroad having incurvations upon

it, however inconsiderable, must be susceptible of varying its energy and speed within very wide limits. This constitutes one of the greatest practical difficulties which the railroad system has to encounter.

Upon common turnpike roads or paved streets, this inconvenience is less than on railroads. The power of traction necessary on these roads is very variable, owing to the want of uniformity in their surfaces; but on a level Macadamised road it is estimated, on an average, by Mr. Gurney, as a 12th part of the weight of the load. Thus a carriage, weighing 12 cwt., would require a power of traction of 1 cwt.; a carriage weighing 6 tons requires a power of traction amounting to half a ton, and so on. The increased power of traction required by an ascent on a turnpike road is estimated exactly in the same manner as for railroads. An ascent of 1 foot in 12 will add to the power of traction necessary on a level an increased power amounting to one-twelfth of the load, and thus such an ascent would require the power of traction to be doubled; but all ascents less abrupt than 1 in 12 would not require the power of traction to be increased in so great a degree as double its amount on the level. It therefore follows, that so great a susceptibility of increase is not necessary in the powers of traction used on common roads in cases of ascent, as in those used on railroads. This arises not from any advantage possessed by common roads compared with railroads, but from the very reverse. The increase to the power of traction required by an ascent on a common road, is exactly the same in amount as that which would be required by an ascent of the same elevation on a railroad. But the power of traction necessary on a level common road is so great, that the increase caused by an ele-

vation becomes no considerable addition; while the power of traction on a level railroad is so small, that the increase produced by the smallest inclination is severely felt.

That a railroad should be effective, it is therefore necessary that a propelling power should be used capable of great variation in its intensity, or that additional powers of traction should be provided at every inclination, or, finally, that, in the original construction of the road, a level be maintained as near as possible, and in no case should the inclination exceed 14 feet in a mile. Valleys must, therefore, be traversed by embankments or aqueducts, and hills intersected by artificial chasms of open cutting. To penetrate them by tunnels, except in very rare cases and short distances, is inexpedient; for the travelling steam-engine generally used on railroads cannot be used in a tunnel, owing to the air being rendered unfit for breathing by the effect of the fire. Besides the resistance that the air in the tunnel will give to the carriage passing through it, even were tunnels practicable, the great original expense of construction forms a strong objection.

A turnpike road, on the other hand, is usually carried in a winding course, through an undulating country, avoiding hills of great acclivity; and though the length will be thereby increased, yet the total expenditure of the power of traction will be diminished.* The power of traction necessary on common roads in different states of repair, or differently constructed, is subject to great variation. Experiments

* I am not aware whether any comparative estimate has been made of the expense of original construction and repairs of turnpike roads and railroads. We suspect that the result of such a calculation would be more favourable to railroads than is generally supposed.

on this power were made by the direction of the commissioners for the Holyhead Road, with a view to ascertain the best mode of constructing and repairing that road. The result of these experiments shows that the power of traction over a level well-constructed pavement, varies from 32 to 39 lbs. for every ton. A waggon, weighing 21 cwt. 8 lbs., drawn over a well-laid pavement in Piccadilly, required a power of traction, varying from 33 to 40 lbs. In a place where the pavement was uneven, and worked into holes, the power was increased to 48 lbs.; but it may be assumed, that the power of traction on the best laid pavement — such as that which may be seen before the new buildings in the Strand, and in Parliament Street, when newly paved — is at the rate of about 32 lbs. to the ton. On a broken stone surface of old flint road, the traction is about 64 lbs., being double that of a pavement. On a gravel road, the power of traction is nearly 150 lbs. to the ton; on a broken stone road, having a rough pavement foundation, the traction is 45 lbs. to the ton.

From these results, it appears that Mr. Gurney's estimate of the comparative traction on railroads and common roads is not supported by experiment. The traction on a railroad being about 9 lbs. in the ton, and that on the best laid pavement being 32, the latter is three and a half times the former. The traction on a well-made stone surface of old flint road is about seven times the traction on a railway. On a gravel road, it is about fifteen times, and on a broken stone road, with a rough pavement foundation, it is about five times the traction of the railway. I may not be, perhaps, far from the truth in assuming that the average traction of level turnpike roads, in the summer or frosty season, is about twelve times that

of railroads; and consequently that the same power acting on a railroad, will always draw or impel twelve times the load which it can transport on a common road. But I am decidedly of opinion that a steam coach or carriage cannot be used on turnpike roads in the winter season, more particularly after a sharp frost, on a new road; and the repairs of the old road will cause that resistance at all times, that will render the attempt useless.

Having noticed the different kinds of roads over which inland transit is effected, I shall now consider the powers of traction, or the motive forces which are used on these roads. These are at present either that of horses or steam-engines.

The law which regulates the expenditure of animal strength in labour, has never yet been accurately ascertained by observation; nevertheless, there are certain general facts known respecting it, which, though not capable of being reduced to a mathematical expression, are yet sufficiently defined to lead to useful conclusions. In all cases where a horse is used as the means of transit, he must, besides the load which he bears, move the weight of his own body, and a great portion of his strength is thus employed. This portion is found to increase at a rapid rate with the velocity, so that as the speed of his motion increases, the quantity of power which he can spare to his load is as rapidly diminished. In fact, between the load which he bears, and the speed with which he is capable of moving it, there is a certain relation, which, if it could be ascertained exactly, and expressed mathematically, would give the whole theory of animal power considered as a mechanical agent. There are two obvious limiting states, between which, at some intermediate point, the effect of the horse's power is

a maximum. There is a certain load which the animal is barely able to support, but unable to move with any useful speed. On the other hand, there is a certain speed, at which the animal is barely able to move his own body, but unable to support any useful load. In both these cases, his useful effect as an agent of labour, vanishes; and between these limits, it varies according to different proportions. An empyrical formula, assigned by Euler, and quoted by numerous mechanical writers, comes perhaps sufficiently near the practical effects for our purposes.* Let us suppose that the greatest speed of which a horse is capable when unloaded, is fifteen miles an hour, and the greatest load which he is capable of bearing without moving with any useful speed, to be divided into 225 equal parts; — then the load which he is capable of bearing at fourteen miles an hour, will be one of these equal parts; that which he is capable of bearing at thirteen miles an hour will be four of these parts; at twelve miles an hour, nine of them, and so on; the load being expressed by the squares of the successive integer numbers increasing as the speed with which he moves is decreased. By multiplying the load by the speed, the useful effect is obtained; and by this mode of calculation, it would follow that the greatest effect of horse power is obtained when the animal moves at one third of that rate which is the greatest of which he is capable when unloaded; and that the load which he bears at that speed will be four-ninths of the greatest load which he is capable of bearing with any useful motion for two hours. From this we may infer generally, that in the use of animal

* Let L be the greatest load which the horse can bear without moving, and V his greatest speed without a load; then if x be any load, and y the corresponding speed, we shall have $V^2x=(V-y)^2L$.

power, as a mechanical mover, advantage is lost with every increase of speed beyond a very moderate limit; and that at certain rates, and those not high in degree, all useful effects disappear.

It is found in practice, that a waggon used on a turnpike road, and loaded to the amount of eight tons, may be drawn by horses, at the rate of two miles and a half an hour,—the horses working for eight hours daily. Thus the performance of a horse in this way will amount to one ton transported twenty miles a-day. A mail-coach, weighing two tons, and travelling at the rate of ten miles an hour, may be worked on a line of road in both directions by a number of horses equal to the number of miles. Thus, the performance of each horse would amount to two tons carried two miles daily, or four tons carried one mile. In the case, however, of horses working in this way, it appears, by a petition of coach proprietors presented to the House of Commons, that it is necessary to renew the stock every third year; from whence we must infer that the animal is overworked.

From what has been explained, respecting the resistance of fluids, and from the relation which I have shown to subsist between the speed of horses and the performances which they are able to effect, it will be apparent that that rate of motion which renders the resistance of a fluid least injurious to the effect produced, is also that speed at which a horse can work with the greatest possible effect. This speed is from two and a half to three miles an hour; and I accordingly find, that when horse power is used to propel a boat on a canal, the effect is a maximum at that rate of motion; but if a higher rate be attempted, I find, as might be easily anticipated from the principles already laid down, that the diminution of effect takes

place in an immensely rapid proportion. Even if the resistance of a fluid were not increased, the effect of a horse's power, by the condition of his nature, would be materially reduced by every increase of speed; and, on the other hand, even were a horse capable of working with the same effect at an increased speed, the resistance of a fluid, increasing in a greater proportion than the square of the speed, would impair the total effect. But, in fact, these two causes co-operate; and both theory and experience agree in the result, that horse power at greater speed than about three miles an hour, is altogether incompatible with any useful effect upon canals; and ten miles an hour on turnpike roads, for any useful purpose.

To render intelligible the advantages which attend the use of steam as a moving power in the transit of loads over land, whether by canals or roads, it will be necessary to premise a few observations respecting the steam-engine. It is a universal property of matter, that by the application of heat, so as to raise its temperature, it suffers an increase in its magnitude. Also in different substances, when certain temperatures are attained by the application of fire or other methods of heating, they undergo a change of form. Solids, at certain temperatures, are converted into liquids; and liquids, in like manner, when heated to certain degrees, become aëriform fluids or gases. These changes are familiar to every one in the ordinary phenomena attending water. Below the temperature of 32° of the common thermometer, that substance exists in the solid form, and is called *ice*. Above that temperature, it passes into the liquid state, and is called *water;* and when raised to the temperature of 212°, under ordinary circumstances, it passes into the aëriform state, and is called *steam*.

It is to this last change that I wish at present principally to call the attention of the reader. In the transition of water from the liquid state to the state of vapour or steam, an immense change of bulk takes place. In this change, a solid inch of water enlarges its size about 1700 times, and forms 1700 solid inches of steam. This expansion takes place accompanied with a certain force of pressure, by which the vapour has a tendency to burst the bounds of any vessel which contains it. The steam which fills 1700 solid inches, at the temperature of 212°, will, if cooled below that temperature, return to the liquid form, and occupy only one solid inch, leaving 1699 solid inches vacant; and, if it be included in a close vessel, leaving the surfaces of that vessel free from the internal pressure to which they were subject before the return of the water to the liquid form. If it be possible, therefore, alternately to convert water into vapour by heat, and to reconvert the vapour into water by cold, I shall be enabled alternately to submit any surface to a pressure equal to the elastic force of the steam, and to relieve it from that pressure, so as to permit it to move in obedience to any other force which may act upon it. Or again, suppose that we are enabled to expose one side of a movable body to the action of water converted into steam, at the moment that we relieve the other side from the like pressure by reconverting the steam which acts upon it into water, the movable body will be impelled by the unresisted pressure of the steam on one side. When it has moved a certain distance in obedience to this force, I suppose that the effects are reversed. Let the steam which pressed it forwards be now reconverted into water, so as to have its action suspended; and at the same moment, let steam raised from water by

heat be caused to act on the other side of the movable body ; the consequence will obviously be, that it will now change the direction of its motion, and return in obedience to the pressure excited on the opposite side. Such is, in fact, the operation of an ordinary low pressure steam-engine. The piston or plug which plays in the cylinder is the mover to which we have referred. The vapour of water is introduced upon one side of that piston at the moment that a similar vapour is converted into water on the other side, and the piston moves by the unresisted action of the steam. When it has arrived at the extremity of the cylinder, the steam which just urged it forward is reconverted into water, the piston is relieved from its action, and returns again to the bottom of the cylinder, by which a partial motion is continued. At the same moment, a fresh supply of steam is introduced upon the other side of the piston, and its pressure causes the piston to be moved in a direction contrary to its former motion. Thus, the piston is moved in the cylinder alternately in the one direction and in the other, with a force equivalent to the pressure of the steam which acts upon it. A strong metal rod proceeds from this piston, and communicates with proper machinery, by which the alternate motion of the piston backwards and forwards, or upwards and downwards in the cylinder, may be communicated to whatever body is intended to be moved.

The power of such a machine will obviously depend on the dimensions of the boiler, and on the magnitude of the piston or the movable surface which is exposed to the action of the steam, and partly on the pressure or temperature of the steam itself. The object of converting the steam into water by cold, upon that side of the piston towards which the motion takes

place, is to relieve the piston from all resistance to the moving power. This renders it unnecessary to use steam of a very high pressure, inasmuch as it will have no resistance to overcome, except the friction of the piston with the cylinder, and the ordinary resistance of the load which it may have to move. Engines constructed upon this principle, not requiring, therefore, steam of a great pressure, have been generally called 'low-pressure engines.' The re-conversion of the steam into water requires a constant and abundant supply of cold water, and a fit apparatus for carrying away the water which becomes heated, in cooling the steam, and for supplying its place by a fresh quantity of cold water. It is obvious, that such an apparatus is incompatible with great simplicity and lightness, nor can it be applied to cases where the engine is worked under circumstances in which a fresh supply of water cannot be had.

The re-conversion of steam into water, or, as it is technically called, the *condensation* of steam, is, however, by no means necessary to the effective operation of a steam-engine. From what has been above said, it will be understood that this effect relieves the piston of a part of the resistance which is opposed to its motion. If that part of the resistance were not removed, the pressure of steam acting upon the other side would be affected in no other way than by having a greater load or resistance to overcome; and, if that pressure were proportionately increased, the effective power of the machine would remain the same. It follows, therefore, that if the steam upon that side of the piston towards which the motion is made were not condensed or expelled, the steam urging the piston forwards on the other side would require to have a degree of intensity greater than the steam in a low-

pressure engine, by the amount of the pressure of the uncondensed steam on the other side of the piston.

An engine working on this principle has, therefore, been called a *high pressure engine.* Such an engine is relieved from the incumbrance of all the condensing apparatus and of the large supply of cold water necessary for the reduction of steam to the liquid form; for, instead of being so reduced, the steam is, in this case, simply allowed to escape into the atmosphere. The operation, therefore, of high-pressure engines will be readily understood. The boiler producing steam of a very powerful pressure, is placed in communication with a cylinder furnished in the usual manner with a piston; the steam is allowed to act upon one side of the piston, so as to impel it from the one end of the cylinder to the other. When it has arrived there, the communication with the boiler is reversed, and the steam is introduced on the other side of the piston, while the steam which has just urged the piston forwards is permitted to escape into the atmosphere. It is evident, that the only resistance to the motion of the piston here, is the pressure of that portion of steam which does not escape into the air; which pressure will be equal to that of the air itself, inasmuch as the steam will continue to escape from the cylinder as long as its elastic force exceeds that of the atmosphere. In this manner the alternate motion of the piston in the cylinder will be continued; the efficient force which urges it being estimated by the excess of the actual pressure of the steam from the boiler above the atmospheric pressure. The superior simplicity and lightness of the high-pressure engine must now be apparent, and these qualities recommend it strongly for all purposes in which the engine itself must be moved from place to place; for

this improvement we are indebted to Mr. Perkins's talented genius.

The steam-engine, therefore, consists of two distinct parts,—the boiler, which is at once the generator and magazine of steam, and the cylinder with its piston, which is the instrument by which this power is brought into operation and rendered effective. The amount of the load or resistance which such a machine is capable of moving, depends upon the intensity or pressure of the steam produced by the boiler, and on the magnitude of the surface of the piston in the cylinder, and the machinery upon which that steam acts. The rate or velocity of the motion depends, not on the power or pressure of the steam, but on the rate at which the boiler is capable of generating it. Every stroke of the piston consumes a cylinder full of steam; and, of course, the rate of the motion depends upon the number of cylinders of steam which the boiler is capable of generating in a given time. These are two points which it is essential should be distinctly understood, in order to comprehend the relative merits of the boilers used in travelling steam-engines, or steam carriages.

The motion which is primarily produced in a steam-engine, is a reciprocating or alternate motion of the piston from end to end of the cylinder; but the motion which is necessary to be produced for the purposes to which the engine is applied, is rarely or never of this nature. This primary motion, therefore, is almost always modified by some machinery interposed between the piston and the object to be moved. The motion most generally required is one of rotation, and this is accomplished by connecting the extremity of the piston-rod with a contrivance constructed on the revolving axle, called a *crank*.

This contrivance does not differ in principle from the common winch, or from the key which winds a clock. The motion of the piston-rod backwards and forwards turns such a winch. At each termination of the stroke, the piston, from the peculiar position of the crank, loses all power over it. To remedy this, two cylinders and pistons are generally used, which act upon two cranks placed on the axle at right angles to each other; so that at the moment when one of the pistons is at the extremity of its stroke, and loses its power upon one crank, the other piston is at the middle of its stroke, and in full operation on the other crank. By these means an unintermitting force is kept in action.

So far as relates to the capability or power of the steam-engine, no difficulty attends its application to inland navigation. Either low pressure or high pressure engines may be applied to this purpose. Lightness and space are of some importance, but not so indispensable as to exclude low-pressure engines from the barges on canals or rivers, if they were preferable upon other accounts. There are, however, obstacles of a nature independent of the qualities of the steam-engine, which seem to preclude the use of steam as a moving power upon canals, except in very rare instances. The agitation of the water produced by any impelling power which acts in the manner of paddle-wheels or oars, as at present constructed, is found to be very destructive to the banks. Attempts have been made to remove this inconvenience by placing a paddle-wheel in the centre of the stern, acting as much as possible in the middle of the canal; and various contrivances have been suggested for feathering the paddles, so as to cause a diminished agitation in the water. None of these contrivances have, how-

ever, succeeded; and, except in the great ship canals in Scotland, steam-boats have not been generally adopted.

One of the principal causes of the advantage which steam posseses over horse power, arises from the circumstance that *speed does not diminish efficiency*. A given quantity of steam, whether produced and expended slowly or quickly, will cost the same sum, and will perform the same work; but this is quite otherwise with horses, as has been already explained. The same quantity of actual labour executed in a short space of time, requires a far greater expenditure of horse power than if it were performed at a slower rate; and hence it follows, in the comparison of the effects of steam power with that of horses, that the advantage of the former is slight, when slow rates of motion only are considered. To give the steam-engine its full advantage, if worked upon canals, it would, therefore, be necessary to propel the boat at a greater speed than $2\frac{1}{2}$ miles an hour,—the rate at which horses can work with the greatest effect. But here again an obstacle is interposed, depending upon the nature and structure of canals. A boat moving in a canal at a higher rate than 3 miles an hour, is found to produce such a surge and motion of the water, as to injure or even destroy the embankments, unless in canals of considerable width, such as the great Caledonian Canal. Were the steam-engine, therefore, applied to propel boats upon any of the ordinary canals, it would be necessary to limit the speed to that rate at which the steam-engine competes with horses with the least advantage. It is probable that, even under these circumstances, in most situations, steam power would be found more economical than that of horses. As the other circumstances, however,

already alluded to, have hitherto excluded the use of the steam-engine upon canals, and, as far as I can now see, are likely to continue its exclusion, it is superfluous here to discuss the comparative merits of its power and that of horses. We must for the present regard the latter as the only power practically available upon canals for general use, and this power generally limited to a speed not exceeding 3 miles an hour.

It is not necessary here to notice particularly the application of a steam-engine upon great rivers and ship canals. There, it has no rival as a moving power, at any speed within twelve miles an hour, and its application is not restricted by any of those difficulties which attach to ordinary canals.

There are two methods by which the steam-engine may be applied to a great advantage to draw or impel carriages on a road. At certain stations, placed at convenient intervals, there may be *fixed steam-engines* which act upon ropes extending along the road; and by working these ropes, may draw any wheel carriages which are attached to them. In this manner, carriages may be drawn from station to station, on a straight line of road upon which engines of this kind may be provided. The other method in general use consists in drawing the carriages by a travelling steam-engine, which impels itself together with its load. In the former method, large and powerful low-pressure, or condensing engines, are admissible; because they are stationary, their weight and complexity are not limited, and a sufficient supply of water may generally be provided at the several stations. The travelling steam-engines must, however, be light in their weight, small in their bulk, and simple in their structure. For this reason,

as well as because the transport of a large quantity of cold water could not be conveniently effected, high-pressure engines alone are preferable to all others for locomotive purposes; and even with these, it is necessary to resort to extraordinary means to combine sufficient powers of steam for the loads that it is necessary to draw, with a sufficient heating power to produce that steam, in the quantity necessary to maintain the speed at which the engine is capable to travel.

A travelling steam-engine is placed like an ordinary carriage, upon four wheels. The axle of one pair of these wheels is furnished with cranks, as already described; which cranks or driving wheel are worked by the pistons of the cylinders of the engine, so as to keep the axles in a constant state of rotation. Upon this axle the wheels are fixed so as to be incapable of turning independent of the axle, as the wheels of a carriage do; consequently, when the engine causes the axle to revolve, it necessarily causes the wheels fixed upon that axle also to revolve. The pressure of the wheels upon the road gives them a certain degree of adhesion, so that they are incapable of slipping. When the axle is turned by the engine, the carriage must therefore advance as the wheels revolve. One stroke of the piston corresponds to one revolution of the wheels; and in one revolution of the wheels, the carriage advances through a space equal to their circumference; consequently every stroke of the piston propels the carriage along the road, through a space equal to the circumference of the working wheels. It is apparent, therefore, that the speed or rate of motion of the carriage will depend on the rate at which the

boiler is capable of supplying sufficient power of steam to the cylinder.

There are two distinct methods of placing the loads upon the engine; one, by placing it on the same carriage with the engine itself; and the other, by causing the carriage which bears the engine to drag after it other carriages containing the load. The latter method has been invariably adopted upon railroads. On common roads, some projectors prefer the one method, some the other. Whichever method be adopted, the pressure necessary to be exerted on the piston, must depend upon the power of the steam to overcome the resistance which the load opposes to its progressive motion upon the road; and this resistance again depends partly on the nature of the road and its inclination to the level, and partly on the weight of the load. Upon level railroads, as has been already observed, the same power is capable of impelling at least twelve times as great a load as upon a good Macadamised turnpike road.

The combination of lightness, power, and speed, which is indispensable to the efficiency of travelling steam-engines, requires that the boilers should be so contrived that a small quantity of water should be exposed to a great heating power. As the furnace must necessarily be small, the fuel must, therefore, be kept in fierce combustion; and for this purpose a powerful draft of air must be maintained through it. The difficulty of accomplishing this, long obstructed the progress of this invention; but a fortunate application of the waste steam which escaped from the cylinder, after having urged the piston, and which had been previously useless, solved this important problem. This steam was carried off by the chim-

ney of the engine; and being introduced into it through a confined jet presented upwards, formed a powerful steam-blast up the chimney, and a draft of corresponding power was consequently produced through the furnace. This admirable contrivance forms one of the most important features in the recent improvements of locomotive engines. Its efficiency will be more fully appreciated when it is considered, that in proportion to the velocity of the engine, the discharge of steam from the cylinder will be more rapid, and thus the draft in the furnace will be most powerful at the moment when its power is most wanted.

An unlimited power of draft in the furnace being thus obtained, a fire of adequate intensity may always be supported. The next object is to expose the water to the action of this fire, under the most advantageous circumstances. A great variety of contrivances have been from time to time suggested for the attainment of this end. All, however, consist in subdividing the water by some means or other, so as to expose an extensive surface of it to the action of the fire. Some have distributed the water in small tubes, through and around which the fire plays. Others have disposed it between thin plates of metal, upon the external surface of which the fire acts, so that a number of thin sheets of water are exposed upon both sides to the action of the fire. Others again have proposed to place the water between two cylinders, nearly equal to one another, so as to have a thin cylindrical shell of water between them, the fire acting both inside and all round the cylinders. A number of such concentrical cylindrical shells of water may thus be exposed to the action of the furnace; the space between the con-

centrical cylinders forming the flues. Others propose to place the water in flat horizontal pans, disposing it in thin strata, the lower surface of which should be exposed to the action of the fire, the upper forming the evaporating surface. It would be impossible, were it even expedient, within the limits of this article, to explain the details of all these various contrivances. I shall, therefore, confine my observations to one or two of those which have either come into practical use, or which I consider to be on the point of doing so.

The locomotive engines constructed by Mr. Stephenson, and used on the Liverpool and Manchester railroad, consist of a cylindrical boiler placed upon its side; the furnace being at one end, and the chimney at the other. This boiler has circular ends, and its length (seven feet) from end to end, is traversed by about 100 copper tubes, each an inch and a half in diameter. These tubes form the only communication between the furnace and the chimney; and therefore through them the draft from the furnace towards the chimney must pass. The furnace is a square chamber, of considerable size, the back of which is connected with the end of the boiler. The sides and top, as well as part of the front, are formed of a double plating of iron, with a small intermediate space. The bottom contains the grate-bars which support the fuel. The space between the plating just mentioned, is filled with water, which communicates with the water in the boiler; and every part of this intermediate space being below the level of the water in the boiler, must necessarily be always filled.

Under these circumstances it will be apparent, that the surface of fire on the grate-bars is upon

every side surrounded by a sheet of water, upon which its radiant heat acts. The blast of air which rises through the grate-bars, and passes through the burning fuel, is carried by the draft through the 100 tubes which traverse the boiler longitudinally. This highly heated air, in passing through the tubes, imparts its heat to the water in the boiler by which they are surrounded; and when it issues into the chimney, it is reduced to nearly the same temperature as the water itself. By these means, the greatest portion of the heat, whether radiated by the fire, or absorbed by the air which passes through it, is imparted to the water; the shell of water surrounding the furnace receiving the radiant heat, while the water surrounding the tubes and the boiler receives as large a portion of the heat absorbed by the air as can be communicated to it. The shell of water surrounding the furnace upon which the heat acts being below the level of the water in the boiler, and being generally heated somewhat more highly than that water, has a tendency to ascend, a current is accordingly established, running from the intermediate space surrounding the furnace to the cylindrical boiler, and a corresponding returning current must of course take place. Thus there is a constant circulation of water between the spaces surrounding the furnace and cylindrical boiler.

A close chamber of some magnitude is constructed at the opposite end of the boiler under the chimney, and in this chamber are placed the working cylinders. In the earlier engines used on the railroad, these cylinders were placed outside the boiler, and were consequently exposed to the atmosphere. A considerable portion of heat was thus lost, the saving of which was completely accomplished by transferring

the cylinders into the chamber under the chimney just mentioned. This chamber receiving in the first instance the hot air which rushes from the tubes, and the exterior surfaces of the cylinders being exposed to its action, their temperature is maintained at nearly the same point as the water in the boiler.

These engines are placed upon four wheels, the greater part of the weight, however, usually resting upon two. Thus in an engine weighing eight tons, five tons rest upon the large wheels, and three on the less. The axle of the greater wheels is cranked, and they are kept in a state of rotation by the engine. In some engines, however, the pistons work the four wheels, and in this case the wheels are of equal size, and subject to equal portions of the weight.

At the time when extensive lines of railroad are in progress, calling into action many millions of capital, and the welfare and property of thousands, and when other lines not less extensive are in contemplation, it would be extremely desirable, were it possible, to give an estimate of the *regular* expense of maintaining and working a railway, which has been already successfully established, and the advantages arising from it as a great comercial speculation. But there are circumstances attending the Liverpool railway which render such an estimate impracticable. The proceedings of the company and their engineer, from the moment when the earth was first opened on the projected line, to the present time, cannot be justly regarded in any other light than as a series of experiments, each successful in itself, but each only the forerunner of improvements by which the previous methods and expedients were superseded. And this was naturally to have been expected, when it is considered, that no great experiment of this nature

was ever before tried; for although railroads, to the number of about sixty exist throughout the kingdom, the majority of which are of earlier date than the Liverpool line, yet they were worked chiefly by horses; and though, in a few cases, locomotive engines were used, their application was never thought of in the manner and to the extent or advantage to which the ambition and enterprise of the Liverpool projectors have aspired. Knowledge was therefore to be gained; and gained it could not be, but at the price of that succession of comparative course of human experience.

It is well known, that in order to stimulate the enterprise of the country, and to ascertain the form of engine best adapted for their purposes, the directors of the company, early in the year 1829, proposed a prize of 500*l.* for the best locomotive engine, which should be produced under certain stipulated conditions. This proposal led to a public trial, at which engines of three distinct forms were produced; one by Mr. Robert Stephenson, son of the engineer of the railway; another by Messrs. Braithwaite and Ericson; and a third by Mr. Timothy Hackworth. Two others were present, but did not undergo any part of the trial. Mr. Stephenson's engine fulfilled all the conditions proposed by the directors, and underwent the whole of the trial: the other two also fulfilled the conditions, but failed, from divers causes, before undergoing that experimental test which was required by the judges. The prize was accordingly with justice awarded to Mr. Stephenson, Jun.

There can be no doubt that this method of exciting competition produced a favourable effect at the time; and most probably the enterprise would not have commenced with the same degree of success without some

such expedient. Nevertheless, it has had also some injurious consequences. It will be easily understood, that an engine may possess great powers and capability of improvement, and yet fail upon a single trial; or it may fail even from accidental causes, unconnected with any defect either in its principle or in its details. The complete success of the engine furnished by Mr. Stephenson appears at once to have fascinated the directors; and whether intentionally or not, the fact is indisputable, that the monopoly of engines has ever since been secured to the manufacturer of this particular form of machine. Even when Mr. Stephenson was unable himself to supply engines as fast as the company required them, and other engine-makers were employed, it was under the most rigorous conditions, to construct the engines upon the same principle and in the same form, or nearly so, as that which Mr. Stephenson had adopted.* Experience, the great parent of all invention and improvement, so far as the railroad afforded it, has thus been exclusively confined to one particular form of engine. Under the influence of this, a succession of improvements, as might have been expected, have been made by the ingenious inventors of the engine above described. These improvements consist partly in the relative proportion and strength of the parts, and partly in the arrangement of the cylinders and their action upon the wheels; but all have been suggested by the results of experiments, upon such a scale as was altogether unattainable, by any part of the vast stock of national talent excluded from the road by those measures of the directors, which limited the engines employed

* Mr. Bury, of Liverpool, has made some engines for the company. He has been allowed to depart from Mr. Stephenson's model in some trifling particulars.

to a single form, without deviation. The whole enterprise of the country was therefore paralysed, in as far as the powers of this road were concerned; with the exception of one individual, who was fortunate enough to obtain a field of exertion, which it must be admitted he did not fail adequately to improve. It is true that upon some occasions the Directors have signified that they were willing to receive proposals for engines of other forms, but upon the condition that their performance should be in no degree inferior to those of the engines used on the road *at the time of making such proposals.* It is scarcely necessary to point out the impolicy and injustice of such conditions, when I consider the advantage possessed by one engineer, in having the exclusive experience of the road as his guide. It would perhaps have been not only a more liberal, but a more wise policy in the Directors, to have encouraged the inventive genius of the country, by affording it in some degree those opportunities and advantages which the possession of so grand an instrument as their railroad placed in their hands; and this might have been done in such a prudent way as would not have exposed them to the charge of unduly rendering the property of the Company subservient to the visionary speculations of unpractised persons.

At the commencement of the undertaking, the fuel consumed was at the rate of about 2 lbs. per ton per mile; and the engines were considered as suited to draw about three times their own weight. Improvements, however, have been successively introduced during the last two years, which have reduced the consumption of fuel in a very considerable degree. I am not able to speak of the actual consumption of fuel in regular work, at this moment. However,

several experiments, in which the consumption of coke was actually observed; and these experiments, made at different periods, may be easily compared one with another. In the experiment made with the Rocket, constructed by Mr. Stephenson at the opening of the railway, the consumption of fuel was found to amount to $1\frac{1}{4}$ lb. of coke per ton per mile, exclusive of the weight of the engine and tender. This rate of consumption was reduced, by increasing the number of tubes in the boiler and other means, to 1 lb. per ton per mile; and more recent experiments have been made, which I have had the advantage of witnessing, and in which a further reduction was accomplished.

The load which the engines are capable of drawing in proportion to their weight, has also been found greatly to exceed that which at first was thought to be the limit of their power. An engine weighing 8 tons is now in ordinary cases loaded to the amount of about 100 tons gross; but even this is below its power of traction; as will appear by the following experiments which were made on the railroad during the present year.

"No. 1. Engine, *Victory*; weight 8 tons, 2 cwt., of which 5 tons, 4 cwt. are on the working wheels; cylinder, 11 inches; stroke, 16 inches diameter; working wheels, 5 feet."

"5th May, 1832. This engine drew from Liverpool to Manchester (30 miles) in 1 hour and 34 minutes, 20 loaded waggons, weighing gross, 92 tons, 19 cwt. 1 quarter; consumption of coke, 929 lbs. net; was assisted up Rainhill plane, $1\frac{1}{2}$ mile, by the Samson.

Speed on the level, - -	18 miles an hour.
Fall of 4 feet in a mile, -	- 21.50.
——— 6 in do. -	- 25.50.
Rise of 8 feet in do. -	- 17.63.
Level sheltered from wind -	- 20

"N.B.—Moderate wind direct a-head; slipped on Chat-moss, and retarded two or three minutes.

"8th May, same engine drew 20 waggons; weight, gross, 90 tons, 7 cwt. 2 quarters, to Manchester, in 1 hour and 41 minutes; stopped to water, &c. 11 minutes, half way, not included in the above; consumption of coke, 1,040 lbs., under the same conditions as first experiment.

Speed on the level, -	- 17.78 miles an hour.
Fall of 4 feet in a mile, -	- 22
——— 5 feet do., -	- 22.25
Rise of 8 feet do., -	- 15

"N.B.—High wind a-head; connecting rod worked hot, being keyed too tight; on arriving at Manchester, pistons found so loose in cylinders that steam blew through, owing to the extra strain up hill.

"*On the 29th of May*, the engine called the Samson (weighing 10 tons 2 cwt., with 14 inch cylinders, and 16 inch stroke; wheels, 4 feet 6 inches diameter, both pair being worked by the engine; steam, 50 lbs. pressure on the square inch of the piston 130 tubes), was attached to, with 50 waggons, laden with merchandise, net weight 150 tons. The engine, with this load, travelled from Liverpool to Manchester, 30 miles in 2 hours and 40 minutes, exclusive of delays for oiling and watering, &c., being at the rate of nearly 12 miles an hour. The speed varied according to the inclinations of the road. Upon a level it was 12 miles an hour; upon a descent of 6 feet in a mile, it was 16 miles an hour; upon a rise of 8 feet in a mile, it was about 9 miles an hour. The weather was calm, the rails very wet, but the wheels did not slip, even in the slowest speed, — except at starting, the rails being at that place soiled and greasy with the slime and dirt to which they are always exposed at the stations. The coke consumed in this journey, exclusive of what was used in getting up the steam, was 1762 lbs., being at the rate of a quarter of a pound per ton per mile."

From these experiments, compared with former results, it must be apparent in how progressive a state the art is, of manufacturing and working locomotive engines; and how difficult it is in such circumstances to make any estimate which may form a fair ground of calculation in future undertakings. When the advancement of this art is so rapidly proceeding a major limit, beyond which the expenses cannot pass; and this limit may be readily deduced

from the published half yearly reports of the Liverpool company. I consider it the more necessary to refer to these reports, and to quote their results, because of the various erroneous statements which have been put into circulation by parties who imagine they have interests counter to railways.

It appears that regular traffic upon the railway commenced on the 16th of September 1830; and a report was published of the operations for $3\frac{1}{2}$ months, up to the 31st of December, 1830. It farther appears, that during that period the profits of the Company amounted to 14,432*l.* 19*s.* 5*d.* Hence, taking the capital invested in this work, and experiments at a million, which is very nearly its amount, the profits during the first $3\frac{1}{2}$ months were at the rate of about five per cent. By subsequent reports, it appears, that for the half year ending the 30th of June, 1832, the profits were above six per cent.; and for the half year ending 31st of December, 1831, at the rate of more than eight per cent. The amount of the half year terminating on the 30th of June, 1832, I believe is not yet published; but it appears from the report published in March last, that a considerable increase of trade took place in the coaching department in the twelve weeks ending the 23d of March, as compared with the corresponding period in the last year, and that a like increase was observed in the traffic in merchandise, and traffic increasing every week.

I may therefore fairly assume, that the profits upon this undertaking have not yet attained that limit at which they will probably fix themselves. The rate at which they will increase, must, no doubt, be accelerated by the improvements which are daily in progress in the art of constructing locomotive

engines; and improvements which extend to every part of their operation, as well as the consumption of fuel, the wear and tear of materials, the cost of manufacture, &c. The expenses of the Company have hitherto been also increased by the circumstance of the engines being started with loads inferior to their power. This disadvantage has been lately, in a certain degree, remedied, by their combining loads of passengers and goods, in each cargo.

The name of a high-pressure engine was long in this country a bugbear, and a sound connected with some undefined and unintelligible notion of danger. It would be very easy to show that the causes which produce the explosion of boilers are not confined in their operation to high pressure engines; that they depend upon circumstances altogether unconnected with the temperature or pressure at which the steam is raised; and, consequently, that such accidents when they do occur, which is very rarely, are as likely to happen in the one class of engines as the other. But the best and most intelligible proof which can be given of the groundlessness of this apprehension, is the fact, that for a period of nearly three years, during which travelling and traffic have continued on the railway, and numerous high-pressure engines have been constantly at work upon it, no accident has ever yet occurred from explosion or from any cause depending on the pressure of the steam. Boilers have burst, it is true; but in bursting they have been attended with no other effect than that of extinguishing the fire, and suspending the journey. Two or three accidents to passengers have occurred, but in every case they have been produced by the want of the most ordinary care on the part of the sufferer, and in only one instance have

they been fatal, although nearly a million of passengers have travelled upon the road. If the number of accidents which have occurred be compared with those which occur upon a mail-coach road with the same number of passengers, the comparison will exhibit in a clear light the superior security for life and limb afforded by the substitution of steam-engines on railroads for horses.

As might be expected under such circumstances, upon occasion of trials of this kind, complaints have been made, and charges of unfair proceedings have been brought against those employed upon the road. The engine men of the Company, and those under them, it is said, upon such occasions screwed down or overloaded the safety-valves of Mr. Stephenson's engines, with a view to give them an unfair advantage; and have secretly inflicted injuries upon those competing with them, for the purpose of disabling them, or impairing their performance. I believe that such complaints have come before the directors, and that they have been found not always groundless. The offender, it is said, has been sometimes dismissed.

I now take leave of this topic, recommending to the directors to consider whether the continuance of the system complained of be consistent with the real interests of their constituents; and the genius of the country, and bringing it to bear upon one of the noblest undertakings which England or any other country in the present or any former age has beheld; — by considering whether it be not advisable not only to be free from suspicion, but to be free even from the appearance of it; — by considering whether it be expedient that the same individual who is the engine *maker* should be the engine *judge;* and

whether the directors, being themselves *carriers*, should not exercise those functions with great caution and prudence, in which their peculiar situation renders it necessary that they should act as *judges* over other carriers competing with them. The conduct of the directors may have been unimpeachable; — the conduct of the engineer may have been free from blame. I make no charge against either; but the public generally will never believe in the purity of the one, or the blamelessness of the other, until the strong appearances which circumstances of their own creating have raised against them be removed.

The next step in the progressive improvement of the art of inland transit, is the adaptation of the steam-engine to propel carriages on common roads. The practicability and advantage of the same power on railroads leads necessarily to enquire, whether there is any and what difference in the quality of railroads and turnpike roads, which would render a power of traction so profitable on the one impracticable on the other. I have seen that the resistance to the rolling motion of a carriage on a well-constructed turnpike road may be fairly estimated, *cæteris paribus*, at about twelve times the resistance on a railroad. It follows, therefore, that whatever be the power of traction used, it will be capable of drawing a load of proportionally less amount on the turnpike road. The surface of a turnpike road is necessarily more uneven than that of a railroad; and, therefore, subject to greater variation in the resistance which it offers to the power of traction. A level railroad may be considered as presenting a nearly uniform resistance; and whatever impelling power is used upon it, it need be susceptible of no change in its intensity. The want of the same evenness on the

surface of a turnpike road, the different states of repair in which different parts of it must necessarily be at any given time, but, above all, the fact that the rolling of the carriages themselves is the means by which the road is for the most part formed, consolidated and rendered smooth, make it necessary that any power of traction used upon it shall be susceptible, as occasion may require, of considerably varied energy. A newly made Macadamised road, presenting a surface of loose broken stones, offers a resistance several times greater than the same road when its surface is worn smooth. Now, as parts of every road are subject occasionally to be in this state, that relation between the power of traction and the load must be observed, which is suited to the most difficult part of the road, as well the effects of a thaw, after a severe frost to be encountered.

I have explained that the effect of incurvations on a road will obstruct the speed, whether it be a railroad or a turnpike road, — but that the increased resistance offered by them on turnpike roads, bears a much smaller *proportion* to the resistance on the level, than is the case in railroads. The increased power, therefore, required by them, is not so great *proportionally* on turnpike roads as on railways; and it may be doubted, whether such increase on the regular mail-coach roads will often exceed that which is necessary to overcome the inequalities of resistance presented by the causes already explained on levels.

From the peculiar mode in which the steam-engine is used in propelling carriages, it follows that no power of traction, however intense, can be available beyond the adhesion of the impelling wheels with the surface of the road, which amount to double the weight of the carriage propelled; since that adhesion forms as it were the fulcrum or purchase by which the moving

power is enabled to propel the carriage. Like the resistance to the rolling motion, this adhesion is subject to much greater variation on common roads than on railroads; and to ascertain its practical power, that point must be taken at which its efficiency is at its lowest limit. This power of adhesion was long supposed to be so slight on common roads, that no considerable load could be impelled by its means. But more recent experience has proved that it is abundantly sufficient, under all ordinary circumstances, not only to propel the carriage, whose load rests upon the working wheels, but also to drag other carriages loaded in its train, ten times its weight on a railroad.

An obstacle was also anticipated to the practicability of this adaptation of the steam-engine, from the supposition that carriages thus constructed and propelled would occasion so rapid a wear and destruction of the turnpike roads, as to render the expenses of the repairs greater than any advantages to be derived from them could compensate. This objection, however, has also proved illusory. On the occasion of a steam-carriage being worked on the road between Gloucester and Cheltenham, for some months in the year 1831; those interested in turnpike roads procured the legislature to pass various acts of parliament, imposing prohibitory tolls on carriages propelled by machinery. A petition for the repeal of those acts was immediately elicited from Mr. Gurney, then the most enterprising and successful of the steam-carriage projectors. A committee of the House of Commons was appointed to receive evidence and to report on this petition; the result of which, was the report to which I have already alluded, and the consequent repeal of the prohibitory toll acts. By the evidence laid before this committee

it was satisfactorily established, not only that carriages propelled by steam were not more injurious than carriages drawn by horses, but that they were considerably less so. To adapt horse coaches to move with the speed necessary for travelling, and for despatches, the tires of the wheels should be of very limited breadth; and latterly, they are even constructed with a round surface, instead of a flat one, towards the road; the section of the tire by a plane through the axle, and at right angles to the wheel, being a semicircle or elongated semi-ellipse. In either case such a wheel must cut up the best and hardest road. The wheels of steam-carriages on the other hand, are most efficient, when constructed with a broad tire, the tires never being less than four or five inches in breadth; and, according to the plans of some projectors, extending even to six or eight inches. The tires being truly cylindrical and not dished, the wheels act upon the road in the manner of rollers, and, instead of wearing it, rather tend to consolidate and render it smooth and firm. Thus a steam-carriage, compared with a horse carriage, in as far as relates to the wheels only, is much less injurious to the road, if, indeed, it can be said to be injurious at all. But a stronger testimony is furnished in favour of steam-carriages by the fact established before the committee,—that the principal part of the wear of roads proceeds, not from wheels but from horses. Indeed, a very slight consideration might have caused this fact to have been foreseen. If the nature of the action of a wheel $2\frac{1}{2}$ inches broad rolling along the road, be compared with the pounding and digging of the iron-shod feet of horses, the question will be readily understood.

From what has been above stated, the qualities

necessary to adapt a locomotive engine to propel carriages on turnpike roads may be easily inferred. Since the resistance of a given load to a propelling power is greater in a twelve-fold proportion than on a railroad, it follows, that with the same power the load drawn must be proportionally or twelve times less. But since a part of this load is the weight of the engine itself, and since this weight must bear some proportion to the entire load, it follows, that engines of equivalent power, to be adapted to common roads, must be lighter than those used on rail roads. But again, this consideration extends to the fuel and water as well as to the engine and boiler. Since a less quantity of water and fuel can be transported, a fresh supply must be taken in at shorter stages, of 6 or 8 miles. The railroad engines can travel about 20 miles without watering, and 30 without taking in fuel on a level railroad.

The steam coaches on common roads must be supplied with water and fuel every stage of 6 or 8 miles. The furnace being necessarily smaller and less powerful than those used in locomotive engines on railroads, the steam can be generated with sufficient abundance and rapidity, only by exposing to the action of the fire a much greater quantity of surface, in proportion to the whole quantity of water, than is attempted in engines on railways; and it is in the attainment of this object that the ingenuity of steam-carriage projectors has been for the most part displayed. It may, therefore, be interesting and useful at the present time, when we are on the eve of witnessing four attempts of steam-carriages on common roads, and when the practicability of the project has been recognised, and the conditions of its tolls regulated by the legislature, to describe one or

two of those machines which seem to be most ripe for practical operation.

The earliest and most enterprising projector in this adaptation of the powers of the steam-engine was Mr. Goldsworthy Gurney. To his perseverance and sagacity the public are indebted for the removal of many erroneous prejudices, which long obstructed the progress of this invention, and discouraged the mechanical skill of the country from taking a direction so beneficial in its effects as this improvement in transport. By journeys, in an experimental carriage, between London and Bath, and frequent trips in various directions near the metropolis, Mr. Gurney gave incontestible experimental proof of the practicability of impelling a carriage on a turnpike road by a steam-engine, with a speed equal to that of the swiftest four-horse coach. He proved, also, that the objection was groundless, that the working wheels would slip round without propelling the carriage; and that a similar objection, that such a carriage could not be driven up considerable hills, was also unfounded. His experimental carriage, though extremely rude and ill-constructed, and subject to many defects, ascended without difficulty, all the hills between London and Bath, as well as the hills on various roads round London, including Stamford Hill, and the hill which ascends from Kentish Town to Highgate, called old Highgate Hill. The last ascent rises at the rate of one foot in twelve from the foot to the corner of the terrace at Holly Lodge. From this point to the top, it is more steep, rising one foot in nine. So steep a hill as this never occurs on any of the lately constructed mail-coach roads in England.

These experiments took place about the year 1826; since which time the engine of Mr. Gurney has undergone very considerable improvements; and this machine may now be considered to have attained a state of perfection which fits it for immediate use for light loads, as a means of transport for passengers and goods, for short stages, but never can pay its expense for construction and conducting it like all the others, but on railroads it can be used to advantage.

The grate-bars of the furnace in this engine, are a series of parallel tubes stretching from the front to the back, and sloping slightly upwards. In the front these tubes are fastened in the side of a strong metal cylinder, which extends across the front under the door of the fire-place. The extremities of the same tubes at the back of the grate are connected with the ends of a corresponding series of upright tubes, which, in fact, form the back of the furnace. The upper extremities of these last tubes are connected with the extremities of a third series, which form the roof of the furnace, sloping slightly upwards from the back towards the front. In the front, their extremities are fastened in the side of a strong metal cylinder, which extends across the front of the fire-place over the fire-door, and corresponds with the other cylinder already described. These two cylinders are connected by two large upright metal tubes, one placed at each side of the fire-door, and forming the sides of the front of the furnace. From this description, it will be easily perceived, that the tubes and cylinders which surround the furnace, afford the means of a complete circulation round it, communicating freely with each other at their several points of connection. The cylinder, which is placed above

the fire-door, communicates by large tubes with another vessel, which is removed from the furnace, and called a *separator*, for a reason which will presently be explained.

Now, suppose the cylinders above and below the fire-door, and the system of tubes surrounding the furnace, which communicate with them, to be filled with water, and a quantity of fuel in a state of combustion placed upon the tubes at the bottom of the furnace which form the grate bars. The heat radiated from this fire, plays on every side upon the tubes forming the back and roof of the furnace,—on the cylinders already mentioned above and below the fire-door in front,—and on the upright tubes at each side of the fire-door. Whatever quantity of heat may pass downwards is received by the water in the tubes forming the bars of the grate. The spaces between the tubes forming the roof and back of the grate are stopped; with the exception of a small space at the lowest part of the back, where the spaces between the tubes are open, and lead to the flue which carries off the draft. This flue passes immediately behind the tubes in the back, and is conducted over the tubes in the roof. The air, which, passing through the fuel, maintains it in vivid combustion, and becomes intensely heated, is thus conducted in contact with that side of the tubes forming the back and roof, which is not exposed to the action of radiant heat. As it passes, it imparts a portion of its heat to the water in these tubes, and finally issues at a reduced temperature into the chimney. Such is the contrivance by which every portion of the caloric given out by the combustion of the fuel is communicated to the water.

The water in the tubes forming the roof of the furnace, being more advantageously exposed to the

action of the fire, becomes more intensely heated, and acquires a tendency to ascend. It is to give play to this tendency, that the tubes in the roof are placed in a direction sloping upwards, as already described. The position of the tubes forming the grate-bars is attended with a like effect. When the engine is in operation, therefore, the water in the boiler is kept in a state of prodigiously rapid circulation round the furnace. The water in the tubes forming the grate-bars, rushes constantly from the front towards the back of the furnace; thence it ascends with rapidity through the upright tubes at the back, and passes from them with equal speed through the tubes in the roof, into the cylinder placed above the fire-door,—a corresponding descending current being continually maintained from this cylinder through the vertical tubes at each side of the fire-door. The steam bubbles which are formed in the tubes surrounding the furnace are carried with this circulating current into the cylinder above the fire-place; whence ascending by their levity, they pass into the vessel already mentioned called the *separator*. The boiler is kept continually filled by a force-pump, which injects water into one of the cylinders which surround the fire-door.

One of the most obvious advantages of this arrangement is, that every part of the metal exposed to the action of the fire, not excepting the grate-bars themselves, is in contact with a rapid stream of water. As fast, therefore, as the metal receives heat from the fire it imparts that heat to the water; and can never itself receive that excessive temperature which would cause its destruction by burning; besides which, all the heat which would thus be expended in producing an injurious effect is here consumed in

producing steam. The form of every part of the boiler being cylindrical, is that which, mechanically considered, is most favourable to strength. I cannot conceive the possibility that a boiler of this kind, properly constructed, and previously proved in the usual way, could, under any supposable circumstances, explode.

When the steam passes from the cylinder above the fire-door to the separator, it is charged with water suspended in it in minute subdivision, — an effect called by engineers *priming*. If the water thus mechanically combined with the steam, were allowed to pass through the engines, several injurious effects would be produced; among which may be mentioned the waste of all the heat which that water would carry with it. This is a defect common, in various degrees, to all the locomotive engines, except the one now under consideration. The purpose of the separator is to disengage or *separate* the water from the steam in which it is mechanically suspended; and this is accomplished merely by allowing it to descend by its gravity to the bottom of the separator. It collects there, and is thence conducted back to the boiler to be circulated again.

The next contrivance which claims notice in this machine is the method of blowing the fire. I have already explained the means adopted in the railway engines for accomplishing this, by throwing the waste steam from the cylinders into the chimney. This, however, is attended with a puffing noise, arising from the sudden blasts of steam ejected by the alternate strokes of the piston, and which is increased by the form of the chimney, and the aperture by which they escape. Such a noise would be inconvenient and objectionable. Yet to put aside the use of the waste

steam in the production of draft, would be to sacrifice the greatest excellence attained in the construction of steam-engines since the discovery of separate condensation; beside which this important improvement may very justly be placed. The difficulty has, however, been overcome without the sacrifice of so great an advantage. Instead of allowing the puffs of steam ejected from the cylinders to pass directly to the flue, Mr. Gurney conducts them to a chamber or receptacle, which serves a purpose analogous to that of the chamber between the upper boards of a forge bellows, converting the intermitting puffs into a steady and continuous blast. The steam compressed in the chamber just mentioned, escapes in a number of small jets presented upwards in the chimney; creating a constant and effective draught through the fire, unaccompanied by any noise.

Such are the more obvious qualities of Mr. Gurney's steam-engine, of which it would not be consistent with the limits of this article to give a more detailed analysis, but which the reader will find more fully described in several published works.

I am aware of but three other locomotive engines which are in a sufficiently forward state to give early promise of being practically exhibited on the road. These are the inventions of Dr. Church of Birmingham, Mr. Hancock of Stratford, Essex, and Mr. James Fraser, Hackney Road, London.

In the engine of Dr. Church, a circular fire-grate is surrounded by a number of upright tubes about three or four feet in height, and bent at the top, so as to return downwards in a siphon form. These tubes are made to serve the purpose of flues, in the same manner as those which traverse the Manchester engines. They are contained within other tubes of

somewhat great diameter, so that a small space is included between the two concentric cylindrical surfaces. This space being filled with water, the fire is surrounded by a vast number of thin cylindrical shells of water, the exterior surfaces of which are exposed to the action of radiant heat, while the interior surfaces receive heat from the air which has passed from the fuel, and is carried off into the atmosphere.

While the subdivision of the water in its exposure to the fire is effected by Dr. Church, by reducing it to thin cylindrical shells, the same end is attained by Mr. Hancock, by arranging it in thin flat plates. His boiler consists of a number of thin plates of iron, placed side by side, at a distance of about an inch asunder. The water is contained between every alternate pair of plates, whilst the fire acts between the intermediate ones. It will be seen that in each case a small quantity of water exposes a very extensive surface to the fire. Mr. Hancock's arrangement, however, is said to have obvious defects. Its form being that of flat planes, exposed to a bursting force at right angles to them, is that which of all others is least conducive to strength; and although, from peculiar circumstances attending this boiler, the fact of its bursting may not be attended with danger, yet its liability to such an accident must be attended with great inconvenience, and cannot be regarded otherwise than a most fatal defect. Another defect, not less important is, that a large portion of the metal exposed to the action of fire contains steam and not water, — a circumstance which should never be permitted in any boiler, — but which is utterly destructive in boilers exposed to extremes of temperature and pressure. The boiler of Dr. Church seems not to be liable in the same degree to these objections;

but I cannot speak respecting it with the same confidence, as the specification of his patent has not yet been enrolled, neither has Mr. Fraser's.

In both these boilers, the draft is produced by a fanner worked by the engine. The inferiority of this to the steam draft, and the great extent to which it must rob the engine of its power, are so obvious that I need not here enlarge upon them.

When it is considered that seven years have now elapsed since the practicability of propelling a carriage on a common road by steam was established by incontestible experiment, it will naturally be enquired, why in a nation celebrated over the world for its mechanical skill and commercial enterprise, and abounding in capital, the project has not yet attained a more advanced stage? The facts detailed in the pamphlet of Mr. Gurney, the title of which is placed at the head of this article, will furnish a solution of this question satisfactory to the reader, and little creditable to some parties, whose conduct is there brought before the public.

It appears that after several years of indefatigable exertion, during which he had to encounter and refute the innumerable objections urged against the scheme, — such as the expense, the public annoyance, the removal of horses from employment, the putting of coachmen, &c., out of bread, and all the hackneyed topics by which great improvements in machinery have been ever opposed, — Mr. Gurney, at length, succeeded in getting a steam carriage established as a public conveyance between Gloucester and Cheltenham in February, 1831. It commenced running on the 21st of that month, and continued until the 22d of June, — a period of four months — during which it performed the journey of nine miles

between these places, a level road, regularly four times a day. It carried in this time upwards of 3000 passengers without a single accident, at a greater speed than that of horse coaches, and at half their fares. The value of the coke expended in this performance was about 50*l.*, — giving an annual rate of 150*l.* for fuel. A horse coach to perform the same work, going at a rate of from eight to nine miles an hour, would have required eighteen horses constantly to be maintained.

The evidence afforded by an experiment continued for such a period was not to be resisted; and it carried conviction to the minds of those who fancied their interests would be affected by the impending change. The project was now to be opposed, not by fair objections, but by any means which unscrupulous men will resort to in a desperate emergency. Agriculturists, trustees of roads, coach proprietors, coach drivers, grooms, stable boys, — all were immediately up in arms. Not a day passed without gross misstatements being industriously and extensively circulated, with a view to deter passengers from choosing the new mode of conveyance. The continuance, however, of successful journeys giving constantly the lie to such reports, deprived them of their poison. The next measure was of a more effectually mischievous and atrocious character. On the 22d of June, a considerable space of the road, about four miles from Gloucester, was found to be overlaid with heaps of loose stones, to the depth of eighteen inches. The road at this place, and indeed generally, was at the time in the most excellent order. The horse carriages in crossing the stones thus laid down were compelled to unload; the steam-carriage, not being built with that degree of strength,

necessary to encounter so extraordinary a strain, had its working axle-tree broken the second time it crossed the stones.

The purpose of laying down the stones was not to be mistaken; and the proprietor of the steam-carriage was strongly urged to adopt some legal mode of redress against the parties wilfully committing such an act for the purpose of obstructing him. In reply, he stated that he would decline any hostile proceeding, and that he "felt only pity and contempt for those who could resort to such means for preventing a great national undertaking."

He, hereupon, determined to strengthen the wheels of his carriage, so as to be enabled to encounter any similar obstacle which public or private malignity might throw in his way. His proceedings, however, were speedily arrested by the discovery that "an immense number of turnpike bills had hastily passed both Houses of Parliament, imposing on carriages worked by machinery prohibitory tolls. In some cases the tolls imposed amounted to 40*s.* at every gate; in others to 48*s.*; and in some to 68*s.*; and as if it were a national object to prevent the possibility of such engines being used, one of these acts applied to the road between Cheltenham and Gloucester."

"Hitherto," says Mr. Gurney, "we had met the objections and difficulties proposed, by physical demonstration; but here was a moral difficulty that could not be removed except upon full investigation. I, therefore, in August petitioned parliament; a committee of the House of Commons was, in consequence, immediately appointed to enquire into the subject. The committee, like all parties unacquainted with the real merits of the question, at first, I believe, considered the subject more visionary than real: how differently their minds were affected in the progress of enquiry may be judged of, when it is stated, that they soon applied for further powers, and deemed the matter worthy of close and deliberate investigation for

three months. During that time some of the first statistical, scientific, and engineering authorities gave voluntary evidence on the subject. The Report, on the 12th of October, was brought up and ordered to be printed."

In the progress of their enquiry, the Committee extended their examination to the principal objections which had been urged to the application of steam on common roads. These were, the danger of explosion, the annoyance to travellers, the fright occasioned to horses by the noise of the machinery, and the smoke and steam which escape at the chimney. The committee state, that they are led to believe, by the result of their enquiries, that the substitution of inanimate for animal power on common roads, is one of the most important improvements in internal communication ever introduced; that its practicability has been fully established; that tolls to an amount which would utterly prohibit the introduction of steam-carriages have been imposed on some roads; that on others the trustees have adopted measures which place such carriages in an unfair position compared with ordinary coaches; and that the causes of these measures are two-fold, — 1st, *A determination on the part of the trustees to obstruct as much as possible the use of steam as a propelling power;* and, 2d, The misapprehension of its effects on roads. The committee consider that legislative protection should be extended to steam-carriages with the least possible delay. Their Report goes on to say, —

"Without increase of cost, we shall obtain a power which will insure a rapidity of internal communication far beyond the utmost speed of horses in draught.

"Nor are the advantages of steam power confined to the greater velocity attained, or to its greater cheapness than horse draught. In the latter, danger is increased, in as large a proportion as expense, by greater speed. In steam power, on the contrary, 'there is no danger of being run away with,

and that of being overturned is greatly diminished. It is difficult to control four such horses as can draw a heavy carriage ten miles per hour, in case they are frightened, or choose to run away; and for quick travelling they must be kept in that state of courage, that they are always inclined for running away, particularly down hills, and at sharp turns of the road. In steam, however, there is little corresponding danger, being perfectly controllable, and capable of exerting its power in reverse in going down hills.'

"Steam has been applied as a power in draught in two ways: in the one, both passengers and engine are placed on the same carriage; in the other, the engine carriage is merely used to draw the carriage in which the load is conveyed. In either case, the probability of danger from explosion has been rendered infinitely small, from the judicious construction of boiler which has been adopted.

"The danger arising to passengers from the breaking of the machinery need scarcely be taken into consideration. It is a mere question of delay, and can scarcely exceed in frequency the casualties which may occur with horses.

"It has been frequently urged against these carriages, that, wherever they shall be introduced, they must effectually prevent all other travelling on the road; as no horse will bear quietly the noise and smoke of the engine.

"The committee believe that these statements are unfounded. Whatever noise may be complained of, arises from the present defective construction of the machinery, and will be corrected as the makers of such carriages gain greater experience. Admitting, even, that the present engines do work with some noise, the effect on horses has been greatly exaggerated. All the witnesses accustomed to travel in these carriages, even on the crowded roads adjacent to the metropolis, have stated, that horses are very seldom, if ever, frightened in passing."

The committee conclude their report by the following summary of propositions, of the truth of which they state that they have received ample evidence:—

1. "That carriages can be propelled by steam on common roads at an average rate of ten miles per hour.

2. "That, at this rate, they have conveyed upwards of fourteen passengers.

3. "That their weight, including engine, fuel, water, and attendants, may be under three tons.

4. "That they can ascend and descend hills of considerable inclination with facility and safety.

5. " That they are perfectly safe for passengers.

6. " That they are not (or need not be), if properly constructed, nuisances to the public.

7. " That they will become a speedier and cheaper mode of conveyance than carriages drawn by horses.

8. " That, as they admit of greater breadth of tire than other carriages, and as the roads are not acted on so injuriously as by the feet of horses in common draught, such carriages will cause less wear of roads than coaches drawn by horses."

The proceedings which rendered necessary the investigation instituted by the Parliamentary Committee, and which justified that committee in reporting " that they had ascertained that a determination existed to obstruct as much as possible the progress of an invention," which they declared to be " one of the most important improvements in internal communication ever introduced," will, doubtless, excite unqualified indignation. That the half-civilised population of Ireland, after ages of misgovernment and oppression, should view with distrust the factories of English settlers, and shrink from a participation in benefits, the nature and extent of which they cannot appreciate, excites no surprise: if they obstruct or occasionally destroy these means of their own civilisation, their defence is found in the irresponsibility inferred by exclusion from instruction. That improvements in machinery, by which labour is superseded, sometimes excite to violence the lower classes of hand artisans, is a matter of just condemnation; but in this case also guilt has its palliation, in the difficulty which uneducated persons find in perceiving that the displacement of labour by machinery is only apparent, or at least temporary, and that the final and never-failing result is an increased demand for hands. The momentary distress which every great change in employment necessarily occasions in a

manufacturing community is also a palliation which should not be overlooked; and it can scarcely be expected that present inconvenience will always be patiently borne by the labouring classes in the prospect of future, and as they may think, uncertain good. But we can find no such defence or palliation for the concoctors of prohibitory toll bills, and for the almost felonious conspirators against the public, who rendered impassable the king's highway, with a view to obstruct and defeat the efforts of those who endeavoured to extend the means by which science ministers to the use and enjoyments of society. The same Parliament which had been formerly misled by false statements, and entrapped into the enactment of unjust laws, soon discovered its error, and exposed the deception practised upon it, not only by retracing its steps and repealing the laws previously enacted, but by substituting for them measures of a directly opposite tendency,—extending legislative protection to the improvement which it was the object of the former enactments to crush. No doubt that the offenders will feel the rebuke implied in this proceeding; and that they will in future be deterred from resorting to modes of annoyance and obstruction, which, though they may elude the grasp of the law, cannot escape the blight of public opinion, in a country where freedom of discussion and the liberty of the press are recognised and established. I have been since informed that this invention and proceedings has proved the ruin of the ingenious Mr. Gurney, who has disposed of his carriage to Sir Charles Dance.

REPORT

OF

THE RESULT OF AN EXPERIMENTAL JOURNEY

UPON THE

MAIL-COACH LINE OF THE HOLYHEAD ROAD,

In Lieutenant-Colonel Sir Charles Dance's Steam Carriage,

ON THE 1st OF NOVEMBER, 1833.

PUBLIC attention having been attracted to the practicability of travelling with locomotive engines upon ordinary turnpike roads, by a report of a committee of the House of Commons, of the 12th of October, 1831, stating that, in the opinion of the committee, the practicability of such mode of travelling had been fully established; and more recently by a report of a journey to and from Brighton having been successfully performed by Lieutenant-Colonel Sir Charles Dance's steam carriage, as well as by the fact that the same carriage was daily in use between London and Greenwich, conveying numerous passengers through the crowded suburbs of the metropolis without the slightest inconvenience to the public; we were desirous of personally making an experiment of the facility with which a carriage of that description could perform a journey of considerable length: and having selected the mail coach line of the Holyhead road for the purpose of such experiment, we made an arrangement with Sir Charles Dance for the use of his carriage, on Friday, the 1st inst.

	tons.	cwt.
* The weight of the carriage, with the water, coke, and three persons upon it, was about -	3	5
* The weight of the omnibus coach attached to it - - - - - - - - - - - - - -	1	0
* The weight of the passengers, their luggage, and some additional sacks of coke, about -	1	15
* Making the gross weight moved - - - - -	6	0

* The motive power was an engine with two cylinders, seven inches in diameter and sixteen inches stroke. The pressure of steam on the tubes constituting the boiler, or generator, was adjusted to 100lbs. per square inch.

Before the carriage had proceeded six miles, one of the tubes of which Sir Charles Dance's boiler is composed, was found to leak so fast as to render repair absolutely necessary: it was also apparent, that the size of the engine was not sufficient to carry so great a weight along a heavy road at any high velocity.

The weather was by no means favourable, there having been much rain in the course of the night and morning, so as to make the road heavy, added to which the winter coating of new materials had in many places been laid upon the road. Notwithstanding these obstacles, upon our arrival at Stony Stratford, 52½ from town, it was found by Messrs. Macneill and Carpmael, who had taken accurate minutes of the loss of time occasioned by stoppages, that the average rate of travelling had been seven miles per hour.

Thus there can be no doubt, that, with a well constructed engine of greater power, a steam carriage conveyance between London and Birmingham, at a velocity unattainable by horses, and limited only by safety, might be maintained; and it is our conviction that such a project might be undertaken with great advantage to the public, more particularly if, as might obviously be the case, without interfering with

* These facts have been ascertained by Mr. Joshua Field, Mr. John Macneill, and Mr. Alexander Gordon, civil engineers.

the general use of the road, a portion of it were to be prepared, and kept in a state most suitable for travelling in locomotive steam carriages.

Thomas Telford,
John Rickman,
C. W. Pasley,
Bryan Donkin,
Timothy Bramah,
James Simpson,
John Thomas,
Joshua Field,
John Macneill,
Alexander Gordon, and
Wm. Carpmael, Civil Engineers.

This Report confirms my foregoing opinion, that a steam carriage may be constructed to travel on common roads, with very light loads. But they cannot be made capable of transmitting goods and passengers to any public or private advantage. If the strength of the engine and carriage is increased, the weight must be increased to eight or ten tons, and eight or ten tons would break down the road, on which they are designed to travel.

London, November, 1833.


40
60

GRAND NORTHERN RAILWAY

from

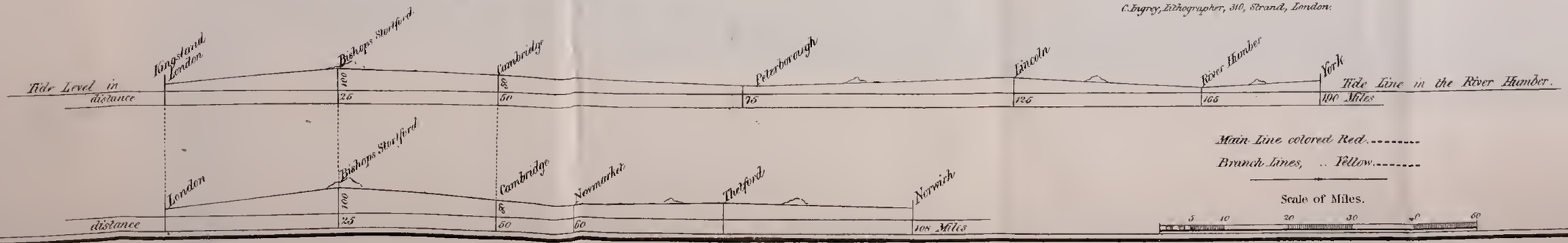
London to York.

WITH A BRANCH TO NORWICH, &c.

Projected by N. W. Cundy, Esq.r Civil Engineer, London.

1853.

C. Ingrey, Lithographer, 310, Strand, London.



Main Line colored Red.

Branch Lines, .. Yellow.

Scale of Miles.

5 10 20 30 40 60

EXTRACTS

FROM

THE MINUTES OF EVIDENCE

GIVEN BEFORE THE

COMMITTEE OF THE LORDS

ON THE

LONDON AND BIRMINGHAM RAILWAY BILL.

DIRECTORS.

London.

Isaac Solly, Esq. *Chairman.*
George Pearkes Barclay, Esq. *Deputy Chairman.*

Edmund Calvert, Esq.
Wm. T. Copeland, Esq. Ald. M. P.
James Gibson, Esq.
George Carr Glyn, Esq.
Pascoe St. Leger Grenfell, Esq.
Geo. G. Larpent, Esq.
John George Shaw Lefevre, Esq.
Sir John Wm. Lubbock, Bart.
George Lyall, Esq.
John Lewis Prevost, Esq.
Henry Rowles, Esq.
Thomas Tooke, Esq.
Henry Warre, Esq.
Alexander Wilson, Esq.

Richard Creed, Esq. *Secretary,*—Office, 69. Cornhill.

Birmingham.

Edmund Peel, Esq. M. P. *Chairman.*
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Daniel Ledsam, Esq.
James Pearson, Esq.
William Phipson, Esq.
Theodore Price, Esq.
Charles Shaw, Esq.
Timothy Smith, Esq.
William Hanbury Sparrow, Esq.
John Sturge, Esq.
John Turner, Esq.
Joseph Walker, Esq.

Capt. Constantine Richard Moorsom, R. N. *Secretary,*
Office, Birmingham.

BANKERS.

London . . . Messrs. Glyn, Hallifax, Mills, & Co.
Birmingham { Messrs. Moilliet, Smith, Pearson, & Moilliet.
The Birmingham Banking Company.

SOLICITORS.

London . . . Messrs. Tooke & Parker, 39. Bedford Row.
Birmingham { Messrs. Barker & Son.
Messrs. Corrie & Carter.

ENGINEERS.

Messrs. George Stephenson & Son.

"WHEREAS the making a Railway with proper Works and Conveniences connected therewith, for the Carriage of Passengers, Goods, and Merchandise from London to Birmingham, will prove of great public advantage, by opening an additional, cheap, certain, and expeditious Communication between the Metropolis, the Port of London, and the large manufacturing town and neighbourhood of Birmingham; and will at the same time facilitate the means of transit and traffic for Passengers, Goods, and Merchandize, between those places and the adjacent districts and the several intermediate towns and places."

The Preamble to the Act for making a Railway from London to Birmingham, of which the above is a copy, was voted on the 1st of June by a large majority of the Committee of the House of Commons, to whom the Bill was referred. On the 8th of July a majority of the Committee of the House of Lords resolved that the Allegations of the same Preamble had not been proved.

The Directors, in publishing a selection from the evidence which was given before the Committee of the Lords, have proceeded on the conviction that the knowledge of the subject which it is calculated to diffuse will act more powerfully in removing those objections of influential persons which occasioned the loss of the former Bill, than any arguments which could be employed by the advocates of the Railway.

The Directors have confined their extracts exclusively to the evidence given before the Lords' Committees; in the first place, because having been given on oath, it is less diffuse than the evidence before the Committee of the House of Commons; and, in the second place, because the Minutes having been printed at length by order of their Lordships, it will be more easy to ascertain, by reference to official documents, the general correctness of the present publication.

Only so much of the evidence has been selected as immediately relates to the following heads: —

First—As to the general utility of the Railway.

Second—As to the estimate of Cost.

Third—As to the Traffic.

Fourth—As to the practical effects of Railways already constructed and in operation.

Although the portion of evidence thus selected is scanty in comparison with the mass which was given in the course of the proceedings on the Bill, the Directors feel confident that it will be sufficient to dissipate the prejudices heretofore entertained against the Railway, and that it will carry the same conviction, as to the general utility of the undertaking, to the minds of others which the original evidence did to the minds of so many of the most distinguished members of the Committees of both Houses; a conviction which induced the noble Chairman of the Committee of the Lords (Lord Wharncliffe) so emphatically to declare at the meeting of Peers, Members of the House of Commons, and other persons favourably disposed to the undertaking, at the Thatched House Tavern, on the 13th of July, at which his Lordship presided—

"He must now say, upon hearing the evidence for the Bill, that he was quite satisfied that this undertaking had the character of a great national measure," and

"That of the many Bills of this description which had come before him in the course of his parliamentary life, he had never seen one passed by either House that was supported by evidence of a more conclusive character."

On this decisive testimony the Directors feel that they might safely rest the case of the Railway; but it is their duty to add that the declaration of the noble Chairman was echoed by the Chairman of the Committee of the Commons, (Sir Gray Skipwith, Bart.) and by every member of the Committees of both Houses present at the meeting, or who has subsequently given the sanction of his name to the resolutions which were then passed.

CLASSIFICATION OF EVIDENCE.

A. (1.) *Commerce.*

A. (2.) *Agriculture.*

A. (3.) *Travelling and Carriage of Goods.*

A. (4.) *Conveyance of Bullion, Mails, Troops, and Military Stores.*

B. *Estimate of Cost.*

C. *Estimate of Traffic.*

D. *Practical Effects of Railways already constructed and in operation.*

Note.—The Numbers to the left of the names denote the Page where the evidence is to be found in the printed Minutes of the Lords' Committees.

The Numbers to the right refer to the Page of the following Abstract of Evidence.

EVIDENCE.

Class A. (1.)— *Commerce.*

Mr. Frederick Barry.—p. 77.

* 1. You are a shipbroker in London?

I am.

2. And have been so many years?

For twenty-five years.

3. Have you been in the habit of dispatching a great number of ships in the course of that time?

Yes.

4. To all quarters of the globe?

To all quarters, but more particularly to Spain and Portugal.

5. Are they loaded chiefly with manufactured goods?

Yes, almost invariably.

6. Are these manufactured goods obtained in a great measure from Birmingham?

A great many of them; some woollen manufactures come from the north, but the principal part comes from Staffordshire and Birmingham.

7. Are there particular ships appointed to sail on particular days from the port of London?

There are particular days for a vessel to sail, and whether the goods arrive or not we send our vessels away. I am owner of a great many.

* The Numbers opposite the Questions denote their order in the printed Minutes of the Lords' Committees.

8. You do not wait till the goods come?

We make arrangements with the merchants for a particular day, and whether the goods arrive or not we go.

9. At what periods do they go?

There are fourteen days between the sailing of the one and the other to Spain; if to Lisbon, nine days; and if to the Havannah, we give them a month.

10. Do you know whether disappointments frequently occur in consequence of goods not arriving?

Invariably, from a great many circumstances, arising from the canal being stopped from freezing or for cleansing, or from other casualties.

11. The exporters from London often suffer considerable inconvenience?

Whether they be merchants or manufacturers they must of necessity suffer.

12. And very materially?

Of course. You may lose a market. Many of the goods are bound for particular ports: some of them have to be transhipped from Manilla. The Spanish ships sail for Cadiz at a certain time, and if you do not get there previous to the sailing of the annual vessels you must stop till the next year.

13. Has that occurred often in your experience?

Frequently; very frequently.

14. Do not the shipowners suffer, as they lose the freight?

Yes; there must be a falling-off to them as well as to the manufacturers.

15. Would this disadvantage be remedied by a more speedy communication?

I take it as common sense that the greater the expedition the more benefit will be derived to all parties, where certainty is to be had.

18. Would the construction of a Railroad between London and Birmingham materially benefit the commerce of this port?

All dispatch and facility must of necessity benefit the port. Almost all the manufactures sent to Germany, the north of Europe, and Russia, must of necessity travel eastward, and every facility for bringing them to London would be a great advantage.

19. The losses and disappointments which you mentioned before would of course be obviated?

In the course of the season many vessels take their departure for the Baltic, and if the manufacturers are thrown out two or three days they are thrown out the whole winter, for the Baltic is frozen up, and they are frozen in; three or four days make all the alteration.

20. Do you often find that goods are stopped on the canal by its being frozen?

One night will stop them; they are also more liable to casualties; they are stopped in cleaning.

21. How often in a year?

I believe twice.

22. They are sometimes shut up in the winter by frost?

I have known them six or seven weeks.

23. During the time there is a cessation of the supply?

Many of the articles will not bear the expence of land carriage; the season operates in some measure on land carriage, but not so effectually as on water. Many articles will not bear the expence, such as iron bars, and so on; we must bring them by water, or we cannot export them at all.

24. In these cases you are obliged to wait till the canals are open?

In point of fact the value of the articles is so small that they cannot bear the expence.

Mr. Henry Hemsley.—p. 84.

1. Do you reside in London?

I do.

2. Are you a director of the Union Flint Glass Company?

I am.

3. Is that company supplied with glass from Birmingham?

We have factories there.

4. How many glasshouses have you in Birmingham?

Eighteen.

5. How is glass at present sent from Birmingham to London?

By canal.

6. Tell us how many tons in the year?

I believe about 1050; I have it from pretty correct data.

7. Would the establishment of a Railroad be a very great advantage to the glass trade of Birmingham and London?

It would be a great advantage, inasmuch as it would shorten the time of transits.

8. Is the glass sent by the fly boats, or the slow boats?

By boats of four days.

9. Is that what they call the fly boats?

The fly boats; the quickest conveyance we have.

10. Do you suffer any commercial inconvenience in your shipping orders by the delay?

We suffer very considerably. It frequently happens that ships are chartered or under engagements to go out on a certain day; when the ship has not her full freight, the owners of the vessel frequently, on their own account, say they will take freight at a certain rate under the ordinary price; any delay that then may arise loses us the order if we cannot get up the goods; if we had two days we could frequently get them. From the peculiar nature of glass manufacture the orders are received on a Monday morning, and we cannot possibly make them till Thursday; by the present conveyance we cannot get them till Monday, and almost all these ships sail on a Saturday. The ships

sail frequently three or six weeks from each other; and although a vessel may be going in the interval she will not take them at a freight which will make it a profitable speculation. Many of our goods are conveyed by coasting vessels, and these coasting vessels always take their departure on a Saturday; our goods arrive on a Monday, and thus we lose a week. I could amplify instances; but the general nature of our trade is, that we cannot make them till Thursday, and we do not get them till Monday.

11. Suppose the Railroad to be established, would goods arrive in time for the ships on Saturday?

Yes. We receive orders for the foreign market for peculiar patterns on Monday; we can make the glass and have it in London ready to be shipped on Saturday. We frequently lose orders because we cannot do that.

12. The great advantage of this proposed Railroad will be the rapidity of communication?

Yes.

13. Besides that advantage, is there any other?

Yes; the saving of breakage.

14. What is your breakage at present?

Our average breakage is two and a half per cent. I take it that 1050 tons made at Birmingham and conveyed by canal come to somewhere about 200,000*l.*, on which our average breakage is two and a half; I consider that on the Railroad it would not be a half per cent.

27. If the Railroad existed, would it be necessary to keep so large a stock in London as you do now?

Not half the amount.

28. Therefore less capital would be employed?

Less capital. A number of our orders are for patterns that we never keep in stock, which are of peculiar make and shape.

29. When you speak of missing the opportunities for foreign orders by delay of communication, do you speak of circumstances which occur frequently, or are they rare?

They occur almost every week; I expect it this week in

an order for Bombay. The ship is to sail on the 5th or 6th of July; it will be impossible to get the goods up by that time; we could get them here by the Saturday if there was a Railway.

Mr. Frederick Barnes.—p. 86.

1. Are you a wholesale ironmonger?

I am.

2. Have you an establishment in Fenchurch-street?

I have.

3. And also an establishment at Birmingham?

I have.

4. Have you occasion to transmit orders for different description of goods to Birmingham?

Daily.

5. Are you concerned in the export trade?

I am.

6. Do you receive some of the packages up by coach?

Three or four every day from different manufactories, and always one or two from our own house.

7. Do you ever find that packages which you require to be conveyed by coach are in consequence expensive?

Very frequently.

8. Is that a considerable embarrassment to your trade?

Very much so.

9. Have you had packages refused by the Albion, the Emerald, or the Greyhound?

Yes. The answer was, "Mr. Barnes, you would not like to travel in a coach with 800 or 900 lbs. on the top of it or in the boot."

10. Have you sustained any loss by it in your business?

Very decidedly; in fact it has been the ruin of our business.

11. Can you give any instances?

I have now an order for a quantity of goods which, if I could get up in the course of two or three days from this,

would be in time for shipment, otherwise they must lie in my warehouse for a month or six weeks, or two months.

12. The rapid transit of these goods by means of a Railroad would enable you to effect those orders on which you at present have these difficulties?

Yes. I sent the order on Thursday night; they would not be able to make the glass till Monday; it will be positively ready on Tuesday, and if I could get it on Wednesday morning it would be in sufficient time. It is for Demerara, and I must bring it up by coach to get it in time. They are shades for candlesticks, and I cannot send the candelabras out without the shades.

Three months ago I had a large order for arms; it is not for me to say where they were going; but they were wanted directly; I did not get them all in time, and many were thrown on my hands, although I shipped some of them at three o'clock on Saturday.

17. Do you then, in point of fact, find from experience that expedition and certainty as to the article you want to export is of the greatest importance to you in your trade?

It is most invaluable to us.

18. If a Railroad was established between Birmingham and London, would it be a considerable benefit to your trade?

Certainly; I am quite sure my business would increase very considerably.

Mr. John Dillon.—p. 165.

1. Are you a silk manufacturer in the city of London?

Yes.

2. Are you in partnership with Mr. Morrison, the member for Ipswich?

I am.

3. Have you long been extensively engaged in the Coventry and Manchester trade?

For some years.

4. How are the great mass of the labouring population of Coventry employed?

Chiefly in the manufacture of ribands.

5. Do almost all these manufactures come to London?

A very large proportion.

6. What proportion?

Nine tenths, I should say.

7. In the article of riband, is a correct and speedy communication with the market desirable?

It is quite indispensable; it is a fancy article, and depends on fashion, so much so that they are always sent by coach, which is an expensive mode of conveyance, except by waggon or wharf.

8. Is it necessary to hold frequent personal communication with the seat of manufacture?

It is very desirable.

9. Have you ever been inconvenienced in consequence of the inadequacy of the present conveyance for that purpose?

We have been inconvenienced in this way: if we have an order for a general assortment of goods, and we happen not to have ribands, for sample, we are obliged to keep the whole of the goods until we write to Coventry; it now requires two days and nights before we can write to Coventry and get the supply that we require.

10. If you had the accommodation to write to Coventry and receive an answer in the evening, would that be a great advantage?

A great advantage to our business and to all our customers generally; a particular advantage to London, where the coaches leave in the morning and few in the middle of the day, to be able to receive an article from Coventry within the twelve hours; if it be only thirteen, one hour more, it compels us to wait till the next morning, the twenty-four hours.

12. From experience, you have no hesitation in stating

that the Railroad would be an immense gain to your trade, and trade generally?

I have no hesitation in saying the gain to our trade, and to trade generally, would be very great.

Mr. Oliver Mason. — p. 70.

1. Where do you live?

At Great Malvern.

2. Where have you resided principally?

For the last twenty-three years at Birmingham.

3. Were you high bailiff for Birmingham last year?

I was.

4. How many years have you been a merchant at Birmingham?

Twenty-three years.

8. Do you think that increased communication between Birmingham and London would be a great advantage to the merchants?

Yes; we should experience great benefit as merchants. We are often put to great loss, and cannot execute orders, by not getting them up in sufficient time. If you lose the opportunity of shipping by a vessel that sails only once a year from a port you lose the order. I have experienced considerable difficulty by that. The correspondent says, if you can ship my goods by such a vessel, send me the order; and if you cannot get them ready you lose in the trade.

9. Do you consider the canal and waggon communication sufficient to enable the merchants to execute their orders with promptitude and certainty?

As to canal communication, there is great inconvenience from stoppages. I remember an instance in which I engaged to ship a quantity of goods to London, and I had an action brought against me for the freight of those goods, which were detained by a stoppage in the canal, and I was called on to pay the freight.

10. In addition to that, the goods were returned on your hands?

Of course they were.

16. If the celerity of delivery was increased by a Railroad communication, would that be an advantage in your competition with the foreigner?

It would be a great benefit to the manufacturer.

54. Do you know, of your own knowledge, that you did lose orders in consequence of the length of time it took to send your goods from Birmingham to London, Liverpool, or any other place of shipment?

I think there were three instances; one about a week before Christmas; we had three instances in which we might have executed orders for 1500*l.* if we could have executed them in time for shipment.

Mr. Edward Tilsley Moore.—p. 76.

1. Do you reside in Birmingham?

I do.

2. Are you a merchant?

I am.

3. Have you experienced any loss or inconvenience in the sale of goods from frost or other impediments in the communication now established?

I have, from frost.

4. State the instance.

Some goods of mine were kept from the 24th of December, 1829, till the 20th of February in the following year. When the goods arrived out, 1200*l.* worth were rejected as being out of time, and I was compelled to make a new arrangement, by which my returns made eighteen months instead of nine.

8. In your opinion, would a cheap, certain, and expeditious conveyance by Railroad from Birmingham to London be a material service to the Birmingham manufacturer?

It would materially assist the manufacturer in the execution of his foreign orders. I am unable to execute an order for a vessel which sails on the 14th of July; I cannot get the goods for the 10th, which is the last day on which a boat sails from Birmingham.

9. If you had a Railroad, could you execute the order?

If I could get twenty-four hours more time I could execute the order.

Mr. Richard Purkess Westall.—p. 88.

1. Are you a linen-draper at Birmingham?

I am.

2. Where do you get your silk mercery, haberdashery, and drapery goods from?

The bulk of them from London.

14. If the proposed Railroad was to take place, would that be an advantage to you, and persons concerned in the same trade?

A very decided advantage.

15. Both in point of rapidity and cheapness of conveyance?

In both points.

16. Is expedition in the execution of an order in your trade of great importance?

Of considerable importance.

17. Is it of that importance that you have goods such as you mention conveyed by coach at so heavy a cost as you allude to?

The majority of goods received from the London market we have by coach; in consequence of the necessity to have them delivered at an early period, in consequence of the change of fashion, we prefer paying treble or quadruple to get them by coach.

18. Are you obliged to make frequent journeys for the purpose of purchasing?

Yes; we go twenty-four times a year.

19. Would the expedition of the Railroad save you time in these journeys?

Unquestionably.

20. Would you come more frequently?

We probably should; we should be compelled to come more frequently. The additional expedition would be a motive for keeping a less stock of goods, and would consequently bring us to the market more frequently.

21. You would require less capital by keeping less goods?

Decidedly.

Mr. Thomas Badger.—p. 99.

1. Do you live at Dudley, Mr. Badger?

I do.

2. Are you a magistrate for the counties of Worcester and Stafford?

I am.

3. In what manufacture are you engaged?

Nails and glass, and other hardwares, as well as flint glass.

6. Would a more expeditious delivery of goods than now exists be a benefit to the glass and nail trade?

Undoubtedly.

7. To which would it be the greatest gain?

To glass.

8. Does it come within your knowledge that some of the manufacturers have established houses in London where they keep large stocks?

Two of the largest houses have.

9. Is that to enable them to supply them with the glass they order?

It is.

10. If there was increased communication, would it enable glass-blowers to dispense with these large stocks?

I think it would.

11. Would the proposed Railroad be advantageous on these grounds?

Most undoubtedly.

23. Are you acquainted with the state of the neighbouring poor in your neighbourhood?

I am.

26. Would the money to be expended in completing the Railroad be a gain to the neighbouring poor in your district?

Most desirable; of immense service.

Class A. (2.)—*Agriculture.*

Mr. W. Meade Warner.—p. 56.

1. Are you a farmer?

I am.

3. Do you occupy any land near Leighton Buzzard?

I do.

4. How many acres?

Nearly 200; and about 400 in Oxfordshire.

6. How near is this land to the proposed line of Railroad?

Within a few poles; about a furlong.

7. Do you consider the proposed Railroad of advantage or disservice to your land there?

A most essential service.

8. In what way do you think it would be advantageous to yourself and other farmers through whose land it passes?

There can be no question at all that the system of farming a grass land, in particular, would be in a considerable degree changed; we should be able to send to London a different kind of produce, and much better.

15. Are you prevented from sending many lambs to the London market from the difficulty of sending them by the road?

Yes; so early as we should otherwise send them.

17. Is it of importance to send lambs early to market?

It is of importance to send them early in the season, as the ewe would feed off earlier.

19. If a Railroad was established, would they be sent by you and other farmers?

No doubt of it.

21. Does the same observation relate to calves that applies to lambs?

Exactly.

22. In respect to any dairy farms, would it be an advantage to the keepers of them to be able to transmit milk and butter to the London market?

I have been a dairyman nearly twenty years, and have forty or fifty cows.

23. Would it be of advantage to have a Railroad to transmit dairy produce to the London market?

Very great. In perishable goods the rule is, that the sooner it is given to the consumer so much the better.

25. How many head of cattle pass weekly through Hockliffe?

In the heavy seasons about 1500.

26. Is that to London?

Yes.

27. About how many sheep?

On the parallel line of road to the proposed Railway there are not fewer than 10,000 weekly, all for the London markets.

28. What is the cost of sending cattle up to London from your neighbourhood?

The charges of the road and selling expenses put together is 10*s*. We estimate about 7*s*. for the road expenses; that is about forty miles.

30. Are the cattle injured from being driven up?

Very much; incalculable.

31. Supposing that even the cost was increased of transmitting cattle by the Railroad, would it be of advantage to

the farmer or not, in your opinion, to have them conveyed by this means, instead of having them driven in the ordinary way?

Then it would be a great advantage. Sometimes the poor things are driven till their feet are sore; and the effect of that is, that they are sold on the road for what they can get. It is often the case that they drive many of them till they have not a foot to stand on.

34. What is charged per score for the driving of sheep?

A shilling a head for about forty miles.

35. Do the same observations you have made previously, apply to sheep as well as the other beasts?

Exactly the same; I scarcely ever see a drove of cattle pass without I see tired ones. They are constantly left at every town on the road, where they are sold for what they will fetch.

36. Have you ever had offers made to you to supply any part of London with milk?

I have.

37. Have you been able to comply with that?

No.

38. For what reason?

On account of the want of conveyance.

51. Is it your opinion as a farmer, from the knowledge that you have of the neighbourhood, that a Railroad established on the proposed line would be an advantage to the two farms?

That opinion alone has brought me here. My property lies in land. I am a proprietor as well as occupier. I believe my estates along the line would be increased in value 30 per cent.

52. Do you believe it would be an advantage to the consumer as well as the producer of the produce?

Very great.

Mr. Charles Whitworth. — p. 62.

1. You are an inhabitant of Northampton?

Yes, I am.

2. Are you a farmer and landowner?

Both a farmer and landowner.

3. Are you also engaged in trade in Northampton?

Yes, I am.

4. Have you ever seen a Railroad?

I have been on the Railroad between Manchester and Liverpool.

5. Have you seen cattle conveyed on the Railroad?

I have seen both beasts and pigs.

6. After cattle have been conveyed on a Railroad, do they land in a good state?

I have seen both pigs and beasts landed, and they came out as fresh as if they came from the field.

10. Do you know of any meat being sent from Northampton to London?

A very great deal.

11. Are you aware of any inconvenience or loss that has occurred to that meat?

I speak from experience. I had meat sent from Northampton, and I had no return whatever for it; it became putrid, and it was thrown away.

12. Do you attribute that to the inadequacy of the speed of the conveyance?

It could not go up in sufficient time to get into the market while it was good; that often happens in summer time, in weather like this.

37. You are an occupier and owner of land?

Yes.

38. To what extent?

I am an owner of 800 acres. I occupy only one.

39. Are the 800 acres in Northamptonshire?

In Northamptonshire and Buckinghamshire.

40. Near the line of this Railway?

The Railway will go only one mile across it; there are 300 acres in a ring fence which it goes right across.

41. What is your opinion as to the effect of the Railroad on the value of that land?

My opinion is, it will increase the value.

42. Have you any doubt on the subject?

No doubt.

43. What do you think would be the reason of its increasing in value?

By the facility of conveyance of any thing that is wanted to be sent to it, or any thing that is wanted to be taken away.

44. The communication by which produce may be exported from the farm?

Yes. Then I should say that we could get manure from the London market, and now we cannot get it within some miles.

45. From what place do you think of obtaining the manure?

From London.

Mr. John Sharp.—p. 65.

1. I believe you are a butcher by trade?

I am.

2. Where have you carried on the business; in London, or in the country?

In High Street, Mary-le-bone, for forty years.

3. Have you been in the habit of receiving beasts from the country for slaughter?

I have been in the habit of buying beasts at Smithfield all the time, weekly.

5. The value of beasts is lessened considerably by the journey?

Much, undoubtedly; when the animal is fatigued and is overdriven, he becomes feverish, and his looks become not

so good, and he loses weight by the length of the journey and the fatigue.

9. Do beasts suffer more from length of journey, or from the time they are away from their usual pasture?

Certainly, the longer they are away from comfortable food and comfortable pasture, the longer they are on the road, the more are they deteriorated in point of quality, generally; always some; sometimes more, sometimes less.

10. Their coming in a shorter time would of course be an advantage?

Beasts that come a short journey, well taken care of, do not suffer so much as those that come long journeys.

15. Do sheep also suffer from being driven?

They do in proportion to beasts.

17. Do calves come from any distance from London, or is the supply confined to a limited distance from London?

I think the farthest distance may be thirty miles; the principal part of the veal of the best quality comes by land carriage; that is our mode; I think very few come more than thirty miles.

18. What distance does the dead meat come if that is now sent up?

It depends on the season of the year and the weather; at this season of the year, from long journeys and the warm weather, it will spoil. In this season of the year the dead meat comes a short distance; in winter, when the season will permit, it comes 100 miles.

19. State how the dead meat is spoilt by the weather and the delay?

If the weather comes in hot it is often the case that a great quantity of meat is spoilt.

20. As to lambs, are they sent at a great distance from London?

Some are sent a great distance.

21. What is the distance?

I know of some lambs coming 80 or 90 miles.

Mr. Robert Attenborough.—p. 67.

1. What are you?

A farmer.

2. And grazier?

Yes.

3. Where do you reside?

At Braybrooke.

4. How far is that from London?

Eighty miles.

5. Are you in the habit of attending Smithfield market?

Yes.

6. How often?

Once a week, from now till Christmas.

7. How long does it take you to perform the journey to and from?

Twelve hours up and down.

8. You are a salesman as well as a grazier?

Yes.

9. What time does it take you to and from, and to transact business in London?

Three whole days and one night; I go down in the night; generally come up on Saturday; then it takes me three days and nights.

10. If you do not come on Saturday, it takes you two days and nights?

Yes; I get home at four o'clock in the morning.

11. Do many other graziers and salesmen come from that neighbourhood?

Yes.

12. What is the expense of coach hire for each journey?

It is 1*l.* 12*s.* inside, and one guinea out.

13. The same to return?

Yes.

14. If there was a conveyance in your neighbourhood, with double the speed of travelling, at a reduction of price,

that would be a great convenience to you and persons in your trade?

Yes; I have considerable business to attend to at home as a farmer.

15. Would the proposed Railroad, if carried into effect, be of advantage to you and persons in your situation?

Not as a salesman; but I think it would as a farmer and grazier.

17. Tell me in what instance it would be serviceable to you?

I think we could get our produce to market at a cheaper rate, and with less waste. I consider our cattle waste considerably by being driven up.

18. What is the present cost of driving up cattle from you to London?

Seven shillings in summer. There are people who drive them for 6*s.* 6*d.* It is 8*s.* in winter.

19. What advance of price would you be willing to pay rather than have your cattle suffer the deterioration of being driven to London?

I would pay 10*s.* a head more.

25. Would a Railroad be equally serviceable for sending dead meat which had been slaughtered in the country?

Yes.

30. What is the charge for driving a sheep?

One shilling a head.

31. How much additional charge would you be willing to incur to have your sheep conveyed?

I think more in proportion to the sheep, because they are longer on the road.

32. Your opinion as a farmer is, that you would be willing to pay more for sheep than beasts?

I have always understood that a sheep driven eighty miles wastes 8 lbs.; that is a stone.

33. At how much a stone?

About 4*s.* 6*d.* a stone; of course there would be a little waste if you travel by the Railroad.

36. Are you acquainted with the Northampton market?

Yes.

39. Do you think that additional buyers would be induced to attend the market if there was a Railroad conveyance in that neighbourhood?

Yes; I consider so. It is now brought there principally by corn dealers, and sent to market again by boat.

47. Do you not hold two farms?

Yes.

48. Are those two farms your own property, or held for any body else?

I hold one as an executor for my brother, and the other I rent.

49. Do you suppose if this Railroad was established that it would be an advantage to you, farming those two farms?

I consider it would, particularly to one I occupy as trustee for my brother; it passes very near to it.

50. Would the value of the farm be raised, in your opinion, by having the Railroad pass it?

I think so.

Mr. William Kay.—p. 143.

1. Where do you reside?

At Tring.

10. Near the line of the proposed Railroad?

I believe about a mile and a half from it.

11. Does the Railroad go through any land of yours?

It does.

13. You do not suppose that any inconvenience would result from the Railroad passing through your land?

Not so far as I am a judge.

14. Do you conceive that your estate would be increased in value by the passage of the Railroad?

I should think it is most likely.

15. Have you any doubt of it?

Not any.

Class A. (3.)—*Travelling and Carriage of Goods.*

Mr. Oliver Mason, *in continuation.*—p. 70.

19. You say you reside at Malvern at present?

I do.

20. When you have occasion to come to London, how many hours are you on the road?

I come up from Worcester by the evening coach in sixteen hours and a half.

21. What is the expense of travelling by that conveyance?

It costs me, including the usual fees, 43*s.*

22. If the proposed Railroad was established between Birmingham and London, would you make that your means of passage from Malvern to London?

Yes. I could go from Malvern to Birmingham in three hours for 10*s.*, and then I should be five hours and a half by the Railroad, which would make nine hours, for which I should have to pay 1*l.* 2*s.*; that would be 32*s.* instead of 43*s.*

23. And a saving of seven hours in time?

Yes.

25. How many miles is Malvern from Birmingham?

Thirty-four.

Mr. H. Cheetham.—p. 96.

1. Are you a cotton manufacturer in the neighbourhood of Manchester?

I am.

2. Are you well acquainted with Manchester and the neighbouring towns?

I am.

11. What is the fare per coach from Manchester to London now?

Four guineas inside, including guard and coachman.

12. What is the expense of posting?

From 1*s.* 3*d.* to 1*s.* 6*d.* per mile.

13. Do you know that persons who travel from Manchester to Chester go by the Railroad to Liverpool?

I do.

14. How much is that round?

Twelve or thirteen miles.

15. Do they save much time and money?

Yes. I recollect at the last election for the county we sent voters by the Railroad to save expense.

16. Are you acquainted with the trade of Nottingham and Leicester?

I am.

17. Do goods go from thence by coach conveyance to London?

Yes; they are obliged to send them by coach on account of the expedition.

20. According to the effects of the Manchester and Liverpool line, do you anticipate that great benefit will accrue to Manchester, from a saving of six hours' communication between London and Manchester?

Yes; and also from the reduction of expense. Between Liverpool and Manchester it has been a reduction to me of 150*l.* per annum on the conveyance of cotton alone. To the Manchester spinner there has been a considerable reduction on the article of coal; as much as 2*s.* per ton, or 20*l.* per cent.

21. Has the communication by canal been improved since the establishment of the Railroad between Liverpool and Manchester?

Very much.

24. Do you know the time at present occupied by the coach from Leicester to London?

About eleven hours.

25. But calculating if the Railroad is executed, what time would be occupied?

It appears by the calculation that passengers would join the Railroad at Rugby, getting from Rugby to Leicester by coach, and the distance would be completed in about six hours and a half.

26. Do you know the expense of coming from Leicester to London by coach now?

About 2*l.* or 2*l.* 2*s.*

27. Have you made an estimate of the tolls demanded by the Railroad company?

It comes to about one guinea.

29. What time is occupied in coming from Nottingham by coach?

From fifteen to sixteen hours.

30. Have you made a calculation of the time occupied in coming by Rugby?

Joining Rugby in the same way, it would be completed in eleven hours; a saving of from six to seven hours.

31. What is the expense of fare by coach from Nottingham?

It costs 35*s.*

32. But calculating the expense by Rugby?

It costs about 25*s.*; the greatest part of the lace made in Nottingham is forwarded by either van or coach; the saving that accrues to a passenger also accrues to the lace.

Class A. (4.) — *Conveyance of Bullion, Mails, Troops, and Military Stores.*

Mr. James Marshall.—p. 145.

1. Are you the secretary to the provincial bank in Ireland?

I am.

2. Do you know that large quantities of bullion have often been forwarded by the Bank of England to Liverpool for transmission to Ireland?

I believe it would be more correct to say that it is obtained from the Bank of England by us to be sent to Ireland.

3. Do you send that to Liverpool?

To Liverpool and to Holyhead occasionally.

4. What time is occupied in the carriage of the bullion?

The direct course of post from London to Dublin is thirty-six hours, provided the packet can sail immediately.

5. Suppose you had the means of communication by a Railroad to Birmingham, which would save six hours in the conveyance of the bullion, do you think that would be of great importance?

The saving of six hours would, on many occasions that I have witnessed, have been of very great importance.

6. Do such occasions sometimes arise, from peculiar circumstances?

Yes; circumstances peculiar to Ireland, for some years back, from political causes, have occasioned sudden demands for gold, which we have been obliged to supply very suddenly.

7. When an hour's time would have been of great importance?

It might, certainly.

Mr. John Moss, *Director of the London and Manchester Railway.*—p. 91.

1. Do you live at Liverpool?

I do.

2. You are well acquainted with Liverpool, Manchester, and the county of Lancaster?

Very well.

9. Tell us whether, in your judgment, it would be of the greatest possible advantage to Liverpool if the mail arrived there on the morning next after it left London?

Of the greatest possible advantage.

10. You are aware of the rate at which locomotive engines travel?

Yes.

11. Can they easily command twenty miles an hour?

Yes.

12. With certainty and precision?

Yes.

59. Do you go the same rate by night as by day?

Exactly the same.

13. Calculating on a Railroad all the way, what time would the mail leaving London arrive in Liverpool?

In about eleven hours.

14. Is it contemplated to have a Railroad from Birmingham to Liverpool?

It is quite arranged for it.

21. If the mail arrived at Liverpool at seven o'clock in the morning, could they arrive the same evening at Dublin?

Perfectly well.

52. Do you know any thing of the transport of bullion from Manchester to Liverpool; has bullion been sent?

Certainly.

53. In a considerable quantity?

A considerable quantity.

54. Do you know whether that has been found of great advantage to the bankers?

It has been a great service to every one.

Mr. H. Cheetham, *in continuation.* — p. 96.

3. What is the market-day at Manchester?

The principal market-day is on a Tuesday.

4. At what time does the mail arrive at Manchester?

At four in the afternoon.

5. Do the foreign letters arrive in time for the market?

All the foreign letters arrive at a time when the market is over.

6. If the mail could be expedited six hours, would that be a great advantage?

It would be a great advantage in this respect: all the country manufacturers who attend the market, the foreign letters not coming in, in time to be delivered that morning, are obliged to stand over until next market-day; the country manufacturer sometimes loses the order, and it is obliged to be given to a Manchester manufacturer.

7. Has this circumstance for a long time been the subject of complaint?

Very much so.

8. If six hours were saved in the communication between London and Birmingham, do you contemplate that great advantage would result to Rochdale, Halifax, Bradford, and Leeds?

Yes.

9. Have you also a great communication between Manchester and Glasgow?

A good deal.

10. The saving of time between Birmingham and London would be a saving of time between Birmingham and Glasgow?

The Glasgow mail leaves Manchester an hour after the London mail comes in.

Mr. Augustus Godby.—p. 142.

1. Are you employed in the Post-office?

I am.

2. In what department?

The secretary to the Post-office for Dublin.

8. Suppose that the Railroad now projected was carried into execution, would it not be a great advantage to convey the mails for Portpatrick, Liverpool, and Holyhead by a conveyance that would save six hours by the direct line?

An earlier arrival at Liverpool and Manchester would be a great advantage, and Glasgow also; I do not know that it would be of any great advantage to Portpatrick.

9. But it would be to Glasgow, Liverpool, and Manchester?

An earlier arrival of six hours at Manchester or any great commercial town would be of great advantage where the present arrival is after seven in the morning.

12. Are you aware that the communication with Ireland would be facilitated by these means?

If it was continued to Liverpool, certainly.

14. The mail arrives in Manchester now about four in the afternoon?

About four o'clock.

15. Six hours' saving would bring it in at ten in the morning?

Yes; that would be a great convenience.

16. It arrives at Liverpool at six in the evening?

Yes.

17. This would bring it in at noon?

It would.

18. At Glasgow, what time does it now arrive?

Four in the afternoon.

19. And at Edinburgh the same time?

It now arrives there at half-past one.

Lieutenant General Sir James Willoughby Gordon, Baronet, K. C. B.—p. 110.

1. Are you the Quarter-master General?

I am.

2. Have you been informed of a proposed line of Railway to be taken from London to Birmingham?

A plan of the Railroad has been laid before me, and I have looked at it.

3. Would it pass near Weedon?

Yes.

4. Is there not a considerable depôt for troops, as well as military stores, at Weedon?

There is.

5. Particularly for military stores?

Both for troops and stores.

6. In your judgment, would a Railroad passing near that depôt afford considerable facilities for the purpose of the transport of military stores?

It certainly would afford very great facilities for the more rapid conveyance of military stores.

7. In your opinion, would that be beneficial to the public service?

Certainly; very beneficial.

8. With respect to troops, would it not, in cases of emergency, afford opportunity for the more rapid conveyance of troops?

In cases of emergency it would be very desirable to send troops by that mode of conveyance, which would be very rapid and safe; in cases not of emergency it is my opinion that troops should not be conveyed by either canal, or carriage, or Railroad, but that they should be made to perform one of the most efficient parts of military duty, to march. In cases of emergency, where bodies of military men require to be assembled suddenly for the public service on any given spot, then I should say that a rapid conveyance is very desirable, and by Railroad certainly; I have practised it on the Railroad between Liverpool and Manchester with very great effect, and benefit to the public service.

9. If a Railroad was extended from London to Liverpool, do you imagine that that would be, in cases of emergency, of great importance to the public service?

Wherever the civil services require a body of troops to be assembled on any given spot, every facility that could be afforded to me to place them on that spot rapidly would be very desirable.

10. Such emergencies have frequently occurred?

They have occurred, and will in all countries not be of unfrequent occurrence.

11. On these occasions you have had recourse to the most expeditious communication you had?

Yes.

22. Do you not think that a rapid communication with Birmingham might expose the stores to some danger?

None whatever; no military stores are placed there without a competent force to protect them against any attempt to spoil them; there is always a competent force for that purpose at Weedon, and every other place where military stores are deposited.

23. There is so good a protection at Weedon that it would take a considerable number of persons to effect that?

Considerable.

24. More than could be brought from Birmingham by the Railroad?

No persons could get there except by the Railroad or by marches, and no assembly of persons could get to Weedon except by two pretty long marches.

25. Suppose these persons were to get possession of the Railroad carriages, and bring 300 or 400 persons to Weedon, to make an attack on the stores, do you think they would be successful against the protection there afforded?

No, nor forty times the number.

Class B.—*Estimates of Cost.*

Mr. Robert Stephenson.—p. 102.

1. You are a civil engineer?

I am.

2. Have you examined this proposed line?

I have.

25. Have you considered the cost which would be necessary to effect this work?

I have.

111. Is the whole aggregate of (*the*) items (*of expense*) 2,205,352*l.*?

It is.

112. In works of this description, is it usual to put a considerable amount for contingencies?

Usually ten per cent.

113. Have you added to this a sum exceeding ten per cent.?

The amount of contingencies at ten per cent. would be 205,000*l.*; I have put it at 294,648*l.*

114. Which makes the sum altogether 2,500,000*l.*?

It does.

115. Look at this paper, and tell me whether the estimate is correct?

It is.

ABSTRACT OF ESTIMATE.

	Estimate proved in the House of Commons.
	£
Excavations and Embankments	779,000
Tunnelling	250,286
Masonry.—This item is increased in consequence of an agreement with the Commissioners of the Metropolitan roads to add to some of our bridges in width and height, also an agreement with the trustees of the Radcliffe Library estates to increase the number of arches in the Wolverton Viaduct, and also an addition of two bridges over the Avon near Brandon to avoid the diversion of the river	350,574
Rails, chairs, keys, and pins	212,940
Blocks and sleepers	102,960
Ballasting and laying rails	102,960
Fencing at 740*l.* per mile	76,032
£	1,874,752
Land	250,000
Six water stations at 500*l.*	3,000
Six intermediate pumps	600
Offices, &c. requisite at each end of the line, for convenience of passengers, &c., and walling for enclosing the space for depôt	16,000
Forty locomotive engines, 1000*l.*	40,000
300 waggons at 30*l.*	9,000
Sixty coaches at 200*l.*	12,000
£	2,205,352
Contingencies	294,648
£	2,500,000

388. Your estimate all the way through is made on two lines?

Yes, it is; except that every five miles there is a side-place or entrance.

389. From which any carriage may turn out and come in again?

Yes.

390. Do you conceive that in 112 miles, where you will not only carry passengers but sheep and pigs, and people are to be allowed to come on from all sorts of side-places, that two lines can be enough?

I am quite sure about that.

391. What makes you sure about it?

It is possible to carry more goods and do more business on two lines of Railroad than there is any probability of coming between London and Birmingham.

Mr. Henry Robinson Palmer.—p. 156.

1. Are you a civil engineer?

I am.

2. Are you the engineer to the London Dock Company?

I am.

5. Have you carefully examined the proposed line of Railroad from London to Birmingham?

I have.

11. At what sum do you estimate the cost of the work, exclusive of contingencies?

1,893,788*l.*

14. Do you know at what sum the land is valued?

The land is valued at 250,000*l.*

15. What would that make your whole estimate?

Mr. Stephenson having estimated the whole cost at 2,500,000*l.*, I have supposed that that sum would be raised for the purpose of the whole work, and have therefore assumed the difference between my estimate and that sum as an item, which I distinguish as contingencies, which

is about 356,000*l.* being a larger sum than is usually allowed for contingencies on public works.

16. In allowing the sum of 356,000*l.*, do you conceive it would be required?

Certainly not; I think the prices I have put on the work throughout will be such as to be sufficient without the aid of that.

17. Do the contingencies come to nineteen per cent.?

About nineteen per cent. on the cost of the work.

Mr. John U. Rastrich.—p. 147.

1. You have been a civil engineer for some years?

I have.

2. You have had some experience in the construction of Railroads?

Yes.

5. Have you gone over Mr. Stephenson's estimate?

I have.

6. Have you been over the whole of the line of Railroad estimated by Mr. Stephenson?

I have.

7. Have you taken pains to calculate whether or not the estimate he has made is correct or not?

I consider his estimate a great deal more than what I should have calculated it at.

8. You think the works might be done on the line from Birmingham to London for less expense than he has estimated?

Yes, I do think so.

34. What is the whole amount of your estimate?

The amount of my estimate, independent of contingencies, is 1,875,527*l.* I have added the remainder to make up 2,500,000*l.*; that makes the contingencies 374,473*l.*

35. Then you have added so large a sum to make your estimate come up to Mr. Stephenson's?

Yes, certainly.

36. Does that include the purchase of land?

No, it does not; the purchase of land is 250,000*l.*—the whole together is 2,500,000*l.*

Class C.—*Estimate of Traffic.*

Captain C. Richard Moorsom, R. N.—p. 47.

1. Have you made a calculation of the number of persons travelling by coach on the roads near the proposed Railroad?

I have.

2. Founded on the Stamp Office returns?

Founded on the Stamp Office List of licensed coaches.

1. PLACES.	2. Weekly Journeys.	3. Average Number of Persons in each Coach.	4. Weekly Passengers.	5. Number of Miles now travelled, not extending beyond Birmingham.	6. Places at which Passengers are assumed to join or leave the Railway.	7. Number of Miles by Railway.	8. Aggregate Number of Miles assumed to be travelled weekly on Railway.
London and Birmingham	124	9	1,116	112	.....	112	124,992
— Chester M.	14	5	70	112	Birmingham	.....	7,840
— Dudley	14	9	126	112	.....	.....	14,112
— Holyhead M.	14	5	70	108	.....	.....	7,840
— Kidderminster	6	9	54	112	.....	.....	6,048
— Liverpool	54	.....	486	108	.....	.....	54,432
— Manchester	108	.....	972	108	.....	.....	108,864
— Shrewsbury	42	.....	378	108	.....	.....	42,336
— Worcester	64	.....	576	108	.....	.....	64,512
— Aylesbury	14	.....	126	40	Near Tring	32	4,032
— Ampthill	12	.....	108	45	Leighton Buzzard	40	4,320
— Banbury	12	.....	108	76	Wolverton	50	5,400
— Bedford	12	.....	108	52	.....	.....	5,400
— Chesham	12	.....	108	29	Berkhampstead	26	2,808
— Derby	12	.....	108	108	Rugby	82	8,856
— Glasgow M	14	5	70	108	.....	82	5,740
— Halifax	14	9	126	108	.....	82	10,332
— Hemel Hempstead	28	.....	252	25	Hemel Hempstead	22	5,544
— Kettering	12	.....	108	76	Blisworth, near Northampton.	60	6,480
— Leighton Buzzard	12	.....	108	40	Leighton Buzzard	40	4,320
— Leicester	14	.....	126	98	Rugby	82	10,332
— Leeds	Half 35	.....	315	108	.....	.....	25,830
— Leamington	12	.....	108	91	Coventry	92	9,936
— Northampton	14	.....	126	66	Blisworth, near Northampton.	60	7,560
— Pinner	14	.....	126	15	Pinner	12	1,512
— Rickmansworth	14	.....	126	20	Watford	15	1,890
— Rugby	6	.....	54	82	Bugby	82	4,428
— Tring	12	.....	108	33	Near Tring	32	3,456
— Two Waters	4	.....	36	24	Near Two Waters	20	720
— Wellingborough	12	.....	108	68	Blisworth, near Northampton.	60	6,480
— Wendover	12	.....	108	37	Near Tring	32	3,456
569,808 miles per week will be 29,630,016 miles per annum, which, at the Railway average Charge of 2*d.* per head per mile, will give 246,916*l.* 16*s.* per annum.						Total of Miles...	569,808

Notes explanatory of the preceding Table.

1. That coaches now run between London and the places specified in the first column. — Stamp Office Returns.

2. That they make the number of journeys per week mentioned in the second column. — Stamp Office Returns.

3. That the average number of passengers in each journey is nine for the coaches and five for the mails, being the numbers mentioned in the third column.

4. That, consequently, the number of passengers per week between London and the places mentioned in the first column is the number stated in the fourth column.

5. That the number of miles now travelled by each coach each journey (not including any distance beyond Birmingham) is that which is stated in the fifth column.

6. That reason, and the experience of the Liverpool and Manchester Railway, show that all passengers will travel the whole or a part of their journey on the Railway whenever they can save time and expense by doing so.

7. That in all the journeys mentioned in the first column, time and expense will be saved to passengers by their joining the Railway at some part of its course, instead of proceeding by the present roads now in use.

8. That the places at which it will be most convenient for passengers performing the journeys mentioned in the first column, to join or leave the Railway by existing roads, will be the places mentioned in the sixth column.

9. That upon this principle the number of miles on the Railway which will be travelled by each passenger in each of the journeys mentioned in the first column will be the number mentioned in the seventh column.

10. That the aggregate number of miles on the Railway which will be travelled by the passengers in each of the journeys mentioned in the first column will amount per week (by multiplying the number in the fourth column by the number in the seventh column) to the number mentioned in the eighth column.

11. That, consequently, the aggregate number of miles on the Railway travelled by the passengers in all the journeys mentioned in the first column will amount per week to 569,808 miles, and for the whole year to 29,630,016 miles.

12. That if the charge for travelling on the Railway be 2*d.* per head per mile, the gross annual income of the Railway from passengers only, who now go by public conveyances, will be 246,916*l.* 16*s.*

4. What is the result of that calculation in money?

246,916*l.* 16*s.*

5. Have you also an estimate of what the result would be if a duty was to be levied on Railroad carriages, corresponding with that now levied on coaches on the common road?

If a duty was levied on them corresponding with the duty paid to government on coaches, it would amount to a farthing per head per mile, which would be a gross sum of 31,000*l.* a year on that calculation.

6. If a duty was imposed, the 31,000*l.* would have to be deducted from the 246,000*l.*?

No; I apprehend that charge would be additional to the charge put down there. It would make a difference of 2*s.* 6*d.* or 3*s.* on the cost to an individual going from Birmingham to London.

Mr. Richard Creed.—p. 177.

1. Are you the secretary to the London and Birmingham Railway Company?

I am.

2. Have you examined the information and evidence supplied by Mr. Hart, Mr. Holman, Mr. Shackel, Mr. Partridge, Mr. Attenborough, and Mr. Warner, of the traffic on the road by coaches, posting, canal boats, &c.?

Yes.

3. What do you calculate that the conveyance of the different articles and persons would amount to at Railroad prices?

At Railroad prices it would amount to 244,858*l.* 8*s.* 10*d.*

4. Is that calculation made on the prices inserted in the schedule of tolls to be taken by the proposed Act?

It is.

5. Have you looked at Captain Moorsom's calculation as to the coach traffic of passengers by Railroad prices?

I have.

6. How much is that?

246,916*l.* 16*s.*

7. Is that calculated at two-pence a mile for each passenger, as proposed to be levied by the Act?

It is so stated in Captain Moorsom's account.

8. In that statement is there any estimate of parcels conveyed by the coaches for the intermediate distances?

There is no allowance.

9. Only the parcels from Birmingham to London, and from London to Birmingham?

Only there.

10. Is there any calculation for goods and parcels that come by vans and carts?

None.

11. Are the goods that come from Liverpool and Manchester, Derbyshire and Leicestershire, and the surrounding counties, included?

There is no allowance made for them, and there is also no allowance made for the increase in the carriage of meat, fish, dairy produce, eggs, and garden produce.

12. Have you examined the evidence given by Mr. Earle, Mr. Moss, and Mr. Booth, relative to the increase of traffic on the Liverpool and Manchester line?

Yes, I have.

13. Taking this evidence as your data, what do you calculate would be the increased traffic on the proposed line of Railroad?

Mr. Booth states that the increase has been in the ratio as to passengers of 1200 to 450*; it may be assumed, therefore, that the number of passengers by the London and Birmingham would be doubled.

14. Then you take it in a less proportion than the actual increase?

Mr. Booth's statement is nearly in the proportion of three to one; I have taken it as two to one.

* See pp. 143, 144. q. 27. 29.

15. Upon that assumed increase on the actual calculated traffic of goods, passengers, and parcels, what do you make the aggregate amount of revenue derived from these sources?

738,692*l.* 0*s.* 10*d.*

16. Was the paper that you hold in your hand drawn up by yourself?

It was.

17. Does it contain the result of the calculations which you have detailed?

It does.

Abstracted from the Minutes of Evidence taken before the Lords Committee on the London and Birmingham Railway Bill, in respect to Traffic.

EVIDENCE.		Rate of Expense as at present. £ s. d.		Rate of Expense at Railway Prices. £ s. d.
Coach Parcels: John Hart.	Coach Parcels, by fourteen Coaches and two Mails, which pass daily each way between London and Birmingham average £2 for each journey, is for one year	23,360 0 0	Same price	23,360 0 0
Posting: Matthew Holman. *	Twenty pair of Post Horses, on an average, pass Hockliffe daily. Taking the average between London and Birmingham at fifteen pair daily, and at 1s. 9d. each mile, the amount for 108 miles for one year is	51,738 15 0	Three persons to each pair of Post Horses is 16,425 for one year; say at 2d. per mile each person for 112 miles	15,330 0 0
Goods by Waggon: John Shackel.	Goods carried on an average by Waggon: Per Ton £. s. d.			
	From Birmingham to London 1,248 Tons at £5. 6,240 0 0			
	From London to Birmingham 1,040 ..... at £3. 3,120 0 0			
	2,288 9,360 0 0		at £2. 6s. 8d. per Ton £5,338 13s. 4d.	
	From intermediate Towns to London and back 1,872 4,270 10 0		at £1. 3s. 4d. ,, £2,184 0s. 0d.	
	4,160			
	Goods taken up, and delivered on the road by Waggons, between London and Birmingham, direct, equal to two thirds of the goods carried the whole distance 6,240 0 0		Two thirds of £5,388 13s. 4d. £3,559 2s. 6d.	11,081 15 6
		19,870 10 0		
Goods by Fly Boats: William Partridge. †	Goods carried on Canal by 35 Fly Boats which pass up weekly, averaging yearly 27,300 Tons, at £2 10s. per Ton 68,250 0 0		at £2 6s. 8d. per Ton £63,700 0s. 0d.	
	Ditto, by 35 Fly Boats passing down, 14,560 Tons, at £2 2s. 6d. per Ton 30,940 0 0		at £2 0s. 6d. ,, £29,120 0s. 0d.	92,820 0 0
		99,190 0 0		
Cattle: Robert Attenborough	1,600 oxen drawn up weekly, on an average for six months in the year, between Coventry and Hockliffe. Estimates driving and loss for 80 miles at 17s. 6d. each ox.			
W. M. Warner.	Estimates driving and loss for 40 miles at 14s. — Say 1600 oxen weekly, for six months, or 41,600 oxen for one year at £1 each for 80 miles	41,600 0 0	at 3d. per ox per mile for 80 miles	41,600 0 0
Robert Attenborough	7,000 sheep driven up weekly, on an average throughout the year; Charge for driving, 1s. Estimates loss in weight 4s. 6d. — Say 7000 sheep weekly is 364,000 for one year at 5s. 6d. each for 80 miles	100,100 0 0	at ½d. per sheep per mile for 80 miles	60,666 13 4
	TOTAL...	335,859 5 0	£	244,858 8 10

* Calculated in the proportion of the coaches between London and Birmingham, allowing twenty pair of post horses from Hockliffe to London, and twelve from Birmingham to Hockliffe, the mean is fifteen pair and a trifling fraction for the whole distance of 108 miles.

† John Norton and Thomas Norton state that 366 fly boats pass Braunston in fourteen days up and down, equal for seven days to 183 boats, being 113 boats more than are included in the above Statement.

SUMMARY OF TRAFFIC AT RAILWAY PRICES.

	£	s.	d.
Statement A. (coach traffic)	246,916	16	0
Statement B. (other traffic)	244,858	8	10
Mr. Henry Booth, in his evidence before the Lords' Committee, states, that the number of passengers on the Liverpool and Manchester Railway is nearly three times what it was by coaches between Liverpool and Manchester before the Railway was opened, or in the proportion of 1200 to 450.	491,775	4	10
It may be presumed, therefore, that at least twice the average number of the passengers by coaches in statement A. would travel by the Railway between London and Birmingham; say	246,916	16	0
Total ..... £	738,692	0	10

Amounting to seven hundred and thirty-eight thousand six hundred and ninety-two pounds and ten-pence.

RICHARD CREED.

Note.—Statement B. does not include:—

1st. Parcels by coaches for intermediate distances.

2d. Vans, market carts, and gigs.

3d. Fly boats conveying Liverpool, Manchester, Derbyshire, and Leicestershire goods which enter the line at different places between London and Birmingham, and only go part of the distance.

Nor is any allowance made for the considerable increase, which may certainly be calculated upon from the carriage of meat, fish, dairy produce, and eggs, and of other articles, not now carried to any extent by the existing modes of conveyance.

Mr. PETER LECOUNT.—p. 50.

1. Have you made yourself acquainted with the traffic on the great roads between London and Birmingham?

I have.

14. Will you have the goodness to look at this Paper, and tell me whether that contains the result of your calculation?

It does.

18. Did you also ascertain the tonnage on the canal?

I did.

General Results of the Traffic on the Line between London and Birmingham for One Year, and the Expenses by the present Means and by the Railway.

Means of Transit.	Number of Journeys of 110 Miles.	No. in each.	Total carried.	Expence by the present Means.		Expense by the Railway, 112¾ miles.	Time. At present.	Time. By the Railway.
			Passengers.		£	Passengers at 2d. per Mile each.	Hours.	Hours.
Four-Horse Coaches counted on the Road	21,641	9	194,769	316499,6				
Two-Horse ditto do. do.	4,221	6	25,326	44003,9				
Pairs of Post Horses do. do.	7,622	3	22,866	83842,0		£		
Commercial Gigs do. do.	5,569	1	5,569	11138,0	455,48	227,819		
Contingent Coaches, from Stamp Office Returns	23,745	9	213,705	347270,6			12½	5½
Proportionate Number of Pairs of Post Horses	6,998	3	20,994	76978,0				
Ditto of Commercial Gigs	5,113	1	5,113	10226,0	434,474	219,827		
		Cwt.	Tons.					
Private and Stage Vans, counted on the road	1,600	18 / 30	2,315¼	18522			30	
Stage Waggons do. do.	3,665	70	12,827½	76965			60	
Errand Carts do. do.	11,543	10	5771½	34629	130,116	58,821	40	
		Tons.						
Boats counted on the Canals	11,1317/11 149 Miles.	11	122,428		306,070	286,940	72	
				£	1,326,143	793,407		

Peter Lecount.

20. What portion have you omitted?

All heavy goods of every kind, and included only what went by the fly boats — general goods.

Class D. —*Practical Effects of Railways.*

Mr. James Forster.— p. 145.

1. Are you a broker in the city of London?

Yes, I am.

2. Are you well acquainted with the value of Canal and Railroad property?

Yes.

3. Will you be kind enough to state whether since the opening of the Liverpool and Manchester Railroad the Canal property has increased or diminished in value?

The Leeds and Liverpool Canal, which is the canal with which it was expected it would interfere the most, has increased in value.

4. Do you know whether the Leeds and Liverpool Canal opposed the application for the Railroad?

They did.

5. Did they do that at considerable expense?

I believe at a very large expense.

6. And did they do that under an apprehension that the Railroad would be found to be prejudicial to the canal?

Yes, I believe they did.

7. Are you able to state to the committee whether it has been found to be so or not?

No, it has not.

8. Will you be good enough to state what were the dividends of the Leeds and Liverpool canal in the year 1829?

20*l.* per annum.

9. Can you inform the committee what they are now?

At present they remain the same as they were in 1829, but a large sum of money has been expended in paying off the debt.

10. Is the income considerably greater now than it was previous to the existence of the Railroad?

Yes; it is considerably greater now, and is improving half-yearly.

Mr. Joseph Pease, *Director of the Stockton and Darlington Railway.*—p. 20.

1. Where do you live?

At Darlington.

2. Are you connected with the Stockton and Darlington Railway?

I am.

3. In what capacity are you?

I have been a Director to the Company from its formation.

4. How long is it since it was formed?

In the year 1822. Ten years.

5. Has it been in constant operation since that time?

The Railroad has been in operation seven years.

6. During the whole time have you been connected with it as a Director?

Yes.

7. Have you directed your attention to the effect that Railway has had on the landed property through which it passes and adjoins?

I consider that I have pretty closely.

8. Have you known any thing of the negotiations that have taken place with the landowners who have purchased property?

I believe I have been privy to every one of them.

9. Have the landowners received full compensation for every damage done or could be done to them by the line of Railroad?

In the course of forty miles we never had but two appeals to the sessions; every other case was adequately compromised.

10. Do you know any instance in which any landowner of the present day considers his land injured by the passage of the Railroad through it?

I am not aware of the existence of one case.

11. Do you know whether the advertisements for the letting of farms or the sales of estates contain any thing relating to the Railroad?

It is invariably stated either that the Railroad passes through the said estate or near to it; I believe invariably.

12. Those advertisements are put forward by sellers?

Yes.

13. You need hardly be asked if they consider it is an advantage?

They consider it as an enhancement of the value of the property.

14. Can you enumerate any instance in which a particular advantage is given to landholders by the line of Railroad passing through their property, or near to them?

The Stockton and Darlington Railway have paid great sums to landowners for gravel, for timber, and stone taken out of their estates, for the making of bricks and a variety of other purposes; they have paid very large sums.

16. Independent of the sums paid to the landholders for the ground taken?

Entirely independent of the sums.

17. Has there been an advantage derived to the roads in the neighbourhood from diminishing the quantity of traffic upon them?

As regards the turnpike roads, I consider they are all of them in a much better state of repair, and as to their funds, than they were prior to the construction of the Railway. I do not know of an exception.

18. Is that from the diminution of the traffic on them?

Of the diminution of that kind of traffic which is most injurious.

19. Are the landowners and the tenants benefited by the reduction in the rates?

I have conversed with many of them, who acknowledge the sums paid to the parochial and other rates are very large.

20. They are benefited then by it?

I take that for granted.

21. To what extent do you pay parochial and other rates?

We are assessed on the amount of our net income.

22. To what yearly amount in round numbers?

I find it impossible, unprepared as I am, to do that; in some parishes it is about half of the whole rates.

23. That is, half of the rates of some of the parishes is borne by the Company?

Yes; and some more than that.

24. Do you consider that the Railroad does any injury to the game on the property?

We have never had but one complaint, four years ago; the Company put down the objection, — the cause of the objection.

29. Are you a landowner yourself in the neighbourhood of the Railroad?

Yes, I am.

30. How near does it pass to your property?

I have one small estate which it intersects in two equal parts, nearly.

31. Does it pass near to the homestead?

It passes through the inclosure in which the homestead stands.

32. Have, then, you or the landowners been benefited in respect of draining by the Railroad passing?

I have, by the cutting fourteen to sixteen feet deep through, that I have sunk myself; and I observe where there were cuttings the landowners do avail themselves of them as drains.

33. Has the rent of that property you speak of, through which it passes, — has that been increased or decreased since the establishment of the Railroad?

I consider it has increased one fifth.

36. Have you known any instance in which there has been a reduction of the rent in consequence of the Railway having passed through the farm?

I have not been able to meet with such an instance.

47. The Company have made an increase to this line in some places beyond what was originally intended?

It was intended for a single way; it is now made double.

48. Were they obliged to treat with the landowners for a large quantity of land?

With a very large proportion of them.

49. Have you paid on those treaties an increased value upon the land from what you would have paid before the line was established at all?

Invariably.

50. To what amount will you say?

I should say we have never objected to pay an advanced price of fifty per cent.

51. In consequence of the increased value from the Railroad?

We were quite aware of the increased value to the owner.

52. You made no objection to that?

No, none.

Mr. Thomas Lee.—p. 24.

1. What is your business?

An architect and surveyor.

2. Where do you reside?

At Chitty Mill near Manchester.

3. Are you employed by several gentlemen of property in that neighbourhood to superintend their estates?

Yes.

4. Do you know the property of Colonel Lee at Newton?
Yes.

6. Is Mr. Trafford a gentleman by whom you are employed?
Yes.

7. Can you tell the committee whether, in an agricultural point of view, Mr. Trafford's and Colonel Lee's property has been improved or deteriorated by the Railroad passing through?
It has been improved.

8. Have you found that the farmers have been benefited in the line?
Yes, at Newton.

9. Have Colonel Lee and Mr. Trafford let their lands at higher rents in consequence of the Railroad?
Both of them.

10. Have you taken any yourself at an increased rent?
Yes.

11. In what proportion?
About three acres.

12. At what increase?
Double the original rent.

13. Do the farmers send their produce to Liverpool and Manchester?
Milk goes regularly.

14. Is that sold at a price greater than they could obtain in the neighbourhood?
I think they get a farthing a quart more than they used to do.

24. Has the land on Colonel Lee's property in the site of the Railroad been occupied for building?
Not a great deal at present, but it is expected; and there has been a very large hotel in consequence of the Railroad passing. He might have sold it for 15,000*l.*

27. Can you tell the committee what the poor rates of Newton are?
One rate at 6*d.* in the pound produced 95*l.*

28. How many rates are there in the year?

Eight.

29. What proportion of the rates do the Railway pay?

20*l.* 7*s.* out of every rate.

30. That is about one fourth?

Yes.

31. Has the Railway produced additional claimants on the poor rate?

I think not.

32. Do you conceive that the establishment of the Railway between Birmingham and London would produce great advantage to the land proprietors in the line?

I consider it would.

60. What is the cost of timber by the Railroad?

I only pay *5s.* for timber; we used to pay 8*s.* 4*d.*

61. You have been asked whether you limited the improvement on Colonel Lee's property to building villas and so on?

No; manufactories as well. I have built a foundery since, and another is in progress.

62. Do you not conceive that the agricultural part of the community in that district will also be benefited to a great extent by the Railroad?

I do.

Mr. Hardman Earle, *Director of the Liverpool and Manchester Railway.*—p. 18.

1. Are you a merchant at Liverpool?

I am.

2. Are you a Director of the Liverpool and Manchester Railroad?

Yes.

3. How long have you been so?

For the last three years.

10. Do you know a house in the neighbourhood of Liverpool called Spekeland?

Yes; it belongs to my mother.

11. How near is it to the Railroad?

Five or six hundred paces.

12. What is the size of that house?

It is a large mansion.

13. What did it cost building?

The house and grounds about 12,000*l.*

14. Have you experienced any inconvenience from residing in that house since the Railway was constructed?

I have not resided there myself; I have been there of course very frequently, and I can say no inconvenience whatever has been expressed.

15. Are the grounds infested by people in consequence of the passage of the locomotive engine?

No.

16. Is there any thing offensive in it?

Nothing whatever.

17. Is there any smoke?

None whatever.

18. Is there any noise?

No; you can hear when the carriages arrive; it is rather an object of interest to persons residing there.

19. Do you know other houses of considerable extent in that part?

I know several; I visit them.

20. Are you able to say whether the inhabitants of those houses are annoyed?

I am enabled to say they do not consider them a nuisance; I have been there, and I should not have been aware of it if I had not heard of it.

31. At the commencement of the undertaking of the Manchester and Liverpool Railroad, were you, or were you not, a determined opponent of that measure?

Yes; my mother was a petitioner against the Bill, and I appeared as evidence against it.

32. From all you have subsequently seen you, would no longer oppose the construction of Railroads at all?

I certainly should not; my opinion is entirely changed, from what I have seen.

33. Are you of opinion that the construction of a Railroad between Birmingham and London would be of great public utility?

Yes, undoubtedly.

36. Do you know of any instance in which this Railway has gone through farming land, in which the value of that land has been raised or depreciated?

Wherever there is any thing like a station it is improved in value; you see advertisements recommending a site because the Manchester and Liverpool line runs near it or through it.

38. Do you know of any instance in which land has been depreciated?

No, I do not; I think I can say positively not on the line of the Liverpool and Manchester Railway.

Mr. J. Moss, *Director of the Liverpool and Manchester Railway* (*in continuation*).

40. Did you know the late Mr. Heywood of Manchester?

Very well.

41. Did he oppose the Manchester and Liverpool Railroad? (*the Line first proposed.*)

Yes.

42. Did he afterwards complain of its not passing through his land?

He complained very much of it.

43. Did you make any alteration afterwards, to accommodate him?

No, we did not.

44. Lord Derby and Lord Sefton objected very much to that (*line*)?

Very strongly.

45. Has there not been a scheme for another Railroad?

Yes.

46. Was that to pass through Lords Derby and Sefton's land?

Yes; they both consented. They threw us back the first year, and we lost such a line as we could never get again; since which they consented to another line going through their property.

47. Do you know Bold Hall?

Very well.

48. Is it a fine house?

Yes, it is.

49. Is that near to the Liverpool and Manchester?

Yes; he complained very much that we made a complete bend, to avoid his property.

50. Did he afterwards wish you to cut off the bend, and go nearer by a straight line?

We arranged with him, and he said he had no objection to the alteration of the line.

51. You agreed to go nearer his premises?

Much nearer to his house.

Mr. Henry Booth, *Treasurer of the Liverpool and Manchester Railway.* — p. 3.

1. Are you acquainted with the Manchester and Liverpool Railway?

I am treasurer.

9. What is the total number of passengers carried within the last twenty-one months?

780,000.

11. What is the average per day?

About 1200.

12. What is the distance of the Railroad from Liverpool to Manchester?

The Railway is thirty miles long, as near as may be.

13. What is the time the first class of the carriages perform that distance?

An hour and a half.

14. The second class?

Two hours.

15. You say upwards of 700,000 were conveyed within the last twenty-one months; pray has any more than one fatal accident occurred during that time?

Only one.

16. How did that occur?

It was a man in the second class of carriages, who insisted on jumping out, against the remonstrance of those who were near it: he jumped out, and was lamed, and died.

17. Against the remonstrance of those who conducted it?

Yes.

18. How many accidents altogether have occurred with the number of passengers that have been conveyed?

Three or four, altogether.

19. Three or four, and only one fatal?

Yes.

20. What is the price of the conveyance of persons by the first class of conveyance?

Five shillings; there is one coach, the mail, which is extra.

21. What is the price of the conveyance of each by the second?

3*s.* 6*d.* each.

23. At any time during the severe weather (1830–1831) were carriages prevented from passing on the Railroad by means of the weather?

No, not once.

24. How many regular coaches were there on the road previous to the establishment of the Railroad between Liverpool and Manchester?

About twenty-two coaches; regular coaches.

27. Have you made a calculation of the number of passengers conveyed by them per day, backwards and forwards?

The greatest number they would hold was about 700; the average might be 450, perhaps.

29. The number of passengers conveyed by these coaches amount to about one third the number conveyed by the Railroad?

Something more than that; the 1200 I have spoken of included road passengers.

30. Nearly one third, or somewhat more than one third, of the number conveyed by the Railroad?

Yes.

31. What is the inside fare by these coaches?

It varied a good deal; but it was about ten shillings inside and six shillings out.

34. What time did it take to convey them?

Four hours in the best description of weather, and four and a half in others.

38. Now to what do you attribute the increased number of passengers on the Railroad, compared with the coaches?

From the cheapness and great expedition and ease of conveyance; for really there is no fatigue in travelling by the Railroad.

42. Then if there were a Railroad established between two such towns as London and Birmingham, have you any reason to doubt an equal increase of travelling by passengers would take place?

I think most probably it would?

62. Has the value of land increased or decreased since the Railroad has been open?

It is a matter of notoriety that it has increased.

63. Do you know any instance in which land has been depreciated in value?

No, I do not know of one.

72. Do you know an instance of troops being transmitted with great facility along the Manchester and Liverpool Railroad?

Yes; we carried troops: we took a whole regiment at the beginning of the year; there were 800, with a large quantity of baggage, which was necessary to be shipped to Ireland.

73. What was the time occupied, from the time they embarked in the carriages till they embarked at the ships at Liverpool?

Little more than three hours; they were about two hours on the way, and went down to the ship's side.

74. And embarked immediately?

Yes.

78. How many persons are constantly in employ on the Manchester and Liverpool Railway?

Between 700 and 800.

83. What were the receipts of the Railroad up to the end of last year; the 31st of December 1831?

The gross receipts for the twelvemonth ending the 31st of December were 155,502*l.*, the disbursements 84,405*l.*

84. What was the balance of clear profit?

71,097*l.*

85. What was the amount of the last dividend paid to the subscribers?

Four and a half per share.

86. That is the half-yearly dividends?

Yes.

87. Then nine per cent. is the yearly dividend?

In that proportion.

88. Is that on the 100*l.* share?

Yes.

89. Do you know at what price the 100*l.* shares sell in the market?

About 200*l.*

90. Now, in consequence of the novelty of the Liverpool and Manchester Railroad, were the expenses that were incurred increased?

Yes; they were heavier than they would have been if we had had more experience.

91. Do you think that a company undertaking a Railroad of the same kind, with the advantage of your experience

before them, would be justified in calculating it at less expense than you incurred?

Yes, I think they would.

99. Do you know the amount contributed in poor's rates by the company to the parishes through which it passes?

About 4,000*l.* per annum.

71. What description of goods are there, besides cottons, carried along the Railway?

Sugar, coffee, rum, corn, and flour in very considerable quantities, and bacon, and almost every description of merchandise.

APPENDIX.

(I.)

Extract from the Minutes of the Proceedings of the Lords Committees, 8th July.

Mr. Follett is heard to sum up the evidence in support of the allegations of the preamble.

The counsel referring in his address to the number of owners who had formerly dissented, but who are now assenting; and the Commitee requiring evidence upon this point, Mr. George Morris Barker says he is authorised to state, that the following persons are now assenting to the measure: namely, George Harris Thomas Caldecott, Richard Lee of Kilsby, Willliam Hart, and Thomas Payne; and that William Butlin desires to be considered neutral.

Mr. William Smith, solicitor to the opponents of the bill, says he is authorised to state, that the following gentlemen are now dissenting to the measure; namely, Thomas Grimston Bucknall Estcourt, Esquire, and Francis Dancer, Esquire.

Mr. Samuel Carter then states, that Thomas Fountain, who appears in the list as an owner of property on the line, is dead, and that the property is now gone among his three sons, Thomas, William, and Newland Fountain; Thomas and William assent to the measure, and Newland dissents. The witness further states, that Mr. Marsden Miles now assents, and that Mr. William Miles is neuter.

Mr. Charles Parker says he is authorised to state, that Col. Henry Samuel Eyre now assents : he also states, that the Dean and Chapter of Christchurch, Oxford, have consented to withdraw their dissent, provided Henry Young, their lessee of the property on the line, should consent; and that Henry Young does assent.

A letter from the treasurer of the Dean and Chapter of Christchurch, to Messrs. Tooke and Parker, solicitors to the bill, stating, that upon certain terms they will withdraw their dissent, provided their lessee, Henry Young, should consent to the measure, is read.

A letter from Henry Young to Messrs. Tooke and Parker, assenting to the bill, is read.

Mr. Harrison submits, that the terms referred to in the letter of the Dean and Chapter should be stated.

Mr. Follett is heard to object to the same.

Mr. Harrison is heard in reply.

Mr. Parker, being asked what is the quantity of the land in question, says, eight acres and a half.

The letter of the treasurer to the Dean and Chapter of Christchurch is, by leave of the Committee, withdrawn, and Henry Young alone is considered to have assented as to his freehold property.

Mr. George Morris Barker states, that John Jeffcoat assents.

Mr John Carter says he is authorised to state, that the following persons are now assenting ; namely, Mary Herne, Anne Herne, Abraham Herbert, Sarah Ray, and William Griffin, and also William Wall Brown for himself and for his co-trustees.

The letter from William Wall Brown is read. It being objected, that he cannot assent for his co-trustees under that letter, the letter is, by leave of the Committee, withdrawn.

Certain letters, authorising the said witnesses to signify the assent of some of the said individuals to the measure (produced by these witnesses), are read.

Mr Follett is heard in continuation of his summing up, and closes his address.

The Counsel and Parties are directed to withdraw.

After discussion ;

It is moved, that the case for the Promoters of the Bill having been concluded, it does not appear to the Committee that they have made out such a case as would warrant the forcing of the proposed Railway through the lands and property of so great a proportion of dissentient landowners and proprietors.

Objected to;

The question is put thereupon?

Resolved in the Affirmative.

Moved, That the allegations of the Preamble have been proved.

The question is put thereupon?

Resolved in the Negative.

The Counsel and Parties are called in, and the Counsel are informed of the Decision of the Committee.

The Counsel and Parties are directed to withdraw.

Ordered, That the Lord in the Chair do report the Decision of the Committee to the House; and that the Committee have not proceeded further in the consideration of the Bill.

(II.)

Meeting of Peers, Members of the House of Commons, and other Persons, favourably disposed to the London and Birmingham Railway, held at the Thatched House Tavern, on Friday the 13th July, 1832.

THE RIGHT HON. LORD WHARNCLIFFE IN THE CHAIR.

The *Chairman* opened the business by observing that the meeting was held to take into consideration the circumstances which occasioned the failure of the London and Birmingham Railway Bill, and the propriety of some expression of opinion as to what further proceedings may be expedient with respect to it.

The *Earl of Denbigh* then rose and moved —

" That, in the opinion of this meeting, a Railway from London to Birmingham will be productive of very great national benefit."

Sir J. Skipwith, M. P. seconded the motion, and stated that no person who duly considered the subject could doubt that the proposed Railway would have been extremely beneficial to the great towns it was intended to unite, to the districts through which it would have passed, and the nation at large.

The resolution was then put, and carried unanimously.

The *Earl of Aylesford* moved the second Resolution —

" That the Bill for effecting this important object having passed the House of Commons after a long and rigorous examination of its merits, it must be presumed that its failure in the House of Lords has arisen from apprehensions on the part of the landowners and proprietors respecting its probable effect on their estates, which this meeting firmly and conscientiously believe to be ill-founded."

This Resolution was seconded by Sir Edward D. Scott, Bart. M. P.

Lord Wharncliffe. Before I put this Resolution, I think it right to make a few observations. There can be no doubt that to this apprehension of the landowners the failure of the Bill must be attributed. The gentlemen who consulted me before I consented to take the chair in the Committee, will remember that I pointed out to them the difficulty which so great a proportion of dissentient landowners would offer to the passing of the Bill; and I begged it might be understood that I went into the Committee entirely unpledged.

I must now say, that upon hearing the evidence for the Bill, I was quite satisfied that this undertaking had the character of a great national measure — not a scheme, like many formed in 1825, for the purpose of profit and traffic in shares — though no doubt it was formed and prosecuted with a view of local benefit to the great towns of London and Birmingham. Having carefully sifted the evidence, I confess I was prepared to support the Bill, unless something should be advanced on the part of the opponents to alter my opinion. I think it right likewise to add, that of the many Bills of this description which have come before me in the course of my parliamentary life, I never saw one passed by either House that was supported by evidence of a more conclusive character.

Of the utility of such a measure no one in the least acquainted with the nature of trade can entertain a doubt — a speedy communication with the ports of shipment or places of consumption, is of vital importance to the manufacturer — there can be no doubt that such a mode of communication as this was proposed to be will be extended not only to Birmingham but to Liverpool, to Lancashire, Yorkshire, and all the manufacturing districts of the North, and will be productive of great national benefit. Still I must contend that it is the business of the legislature to protect the property of the parties through whose lands the line would pass, to assure itself that all practicable measures have been taken to satisfy those persons whose pro-

perty is to be invaded, and who, I must think, ought never to be hurried and forced, but rather wooed and won.

Gentlemen, I have the greatest hopes that in the future progress of the business such conduct will be pursued, and if so, I am quite ready to say that it shall have my best assistance in Parliament; — could I suppose that a different line of conduct would be adopted, and threats and intimidations had recourse to, I should feel compelled to oppose the measure both in Parliament and out of it. But I have great confidence that none but conciliatory measures will be pursued, and in that case the promoters of the Bill may rely upon my best exertions in their favour.

F. Lawley, Esq. M. P. I should not have ventured to address this meeting, had I not diligently and studiously attended, as was my duty, the proceedings on the Bill in the Committee of the House of Commons every day it sat, and therefore am more favourably circumstanced even than your Lordship for forming a judgement on the subject, having heard not only the evidence in favour of the measure, but all that could be alleged against it; and I can safely say, and say it with more confidence as my opinion perfectly coincides with that of your Lordship, that I went into the Committee pained and grieved that so many landed proprietors dissented from the measure, and feeling, like your Lordship, that it was my duty to afford them every protection; but I came out of the Committee fully convinced that the fears they entertained of injury to their property, or interference with their comfort and convenience, were entirely unfounded. I declare I would not otherwise have supported the measure as I have done.

There was one word which fell from your Lordship to which I cannot forbear adverting; I mean the word intimidation: and I avow that if I saw any endeavour to use intimidation in support of this or any other measure, it should have my determined opposition: but knowing as I do most of the gentlemen who are the principal promoters of this measure, I can assure your Lordship they are the last men in the world who would attempt to carry any measure by such means.

The second Resolution was then put and carried unanimously.

The *Earl of Caledon* moved the third Resolution, which was seconded by J. H. Foley, Esq. M. P.

" That consequently this meeting see no parliamentary or other grounds for abandoning this great undertaking, convinced as they are, that by timely explanations and a continuance of judicious management, the difficulties which occurred in the

progress of the Bill may be removed in the ensuing Session of Parliament."

Lord Wharncliffe. Before I put the Resolution, I beg to state that I have never seen a Committee in the House of Lords, that attended more strictly to the examination of the points before them. When we had concluded the case of the promoters, one of the Peers who opposed the Bill said, that notwithstanding all that had been alleged in its favour, he could not make up his mind to force this measure upon so many dissentient landed proprietors, and he thought it right, for the saving both of time and expense, to make a motion to that effect immediately. You are acquainted with the result of that motion; and I must say, as far as I could judge from my own observations and the best information I could obtain, a similar result would have taken place had the Committee divided on any preceding day of its sitting.

I make these observations in consequence of a rumour that it was intended to impugn the decision of the Committee in the House of Lords. I add, that had I observed the least unfairness, I would myself have been the first to bring it before the House. It has been the object of my whole life to prevent all such proceedings in every Committee I attended. His Lordship then put the third Resolution, which was carried unanimously.

J. H. Foley, Esq. M. P. I beg to make a few observations on the latter part of this Resolution. It is my earnest hope that the effect of this meeting will be to produce a favourable result to the measure on a future occasion. I live in the neighbourhood with which this measure is particularly connected, and I know most of the gentlemen who are concerned in promoting it, and I am sure there are not more honourable men living. I attended the whole of the case in the House of Commons, and firmly believe there never was a measure more fairly brought forward. There is a most intense interest about it in my own neighbourhood; a great depression has existed in the manufacture of that district, and all were looking with anxiety for the success of this measure, which it was hoped and believed would have tended to afford them relief. I think its success would have caused an excitement at this moment most peculiarly desirable. I trust this Resolution will tend to remove any prejudices which may exist against it, and at the earliest possible period to ensure its success.

Thomas Paget, Esq. M. P. said he had been on the Committee of the House of Commons to which this measure had been referred, and had been impressed with a deep conviction of the benefits which would have resulted from it. At the same time he quite agreed in the observation of the Noble Chairman, and had no doubt the promoters of the measure would pursue

the line of conduct which his Lordship recommended. It might be of some service to state, that a Railway passed through an estate of his own; that at first he was opposed to it, but the benefits, the pecuniary benefits, arising from the enhanced value of the property, had been such as to convince him that in opposing it he opposed his own interests, and he was satisfied that in the event other landowners would come to the same conclusion. This observation of course did not apply to cases in which the ornamented domains — the pleasure grounds — the privacy — of gentlemen may be invaded; their comforts or even their feelings disregarded. On the proposed Railway from London to Birmingham he believed not a single instance of this nature occurred. No pains, no expense had been spared to effect so desirable an object. Were all the facts which had been given in evidence, as to the increased value of lands from improved modes of communication, collected and laid before the opposing proprietors, he was satisfied that time and consideration would convince them that, in opposing the Railway, they were influenced, in the language of the Resolution, by " ill-founded apprehensions."

Colonel Torrens, M. P. My Lord, I entirely concur in the judicious remarks which have been made with respect to the necessity of avoiding intimidation, and I beg leave to say one word, just to express my own opinion, that every species of intimidation would not only be improper, but entirely unnecessary, because the utility of a measure of this kind rests upon grounds so plain and so easily made out, that it only requires a little time and a little plain statement of the question to convince the landed proprietors on the line, who are now averse to it. It is my opinion, and an opinion formed upon some reflection, that every thing which has a tendency to diminish the cost of carriage of goods or agricultural produce, must have a similar effect to that which would be produced by increasing the fertility of the soil itself, and therefore the landowners in this kingdom in particular are the persons most interested in every thing that tends to cheapen and quicken carriage. (*hear, hear.*)

Lord Wharncliffe. I entirely concur in what has fallen from the gentleman who has just spoken. In my judgment, there cannot be a greater mistake, on the part of the landholders, than to think a Railway through their lands would improve injurious to them. On the contrary, it will tend to increase their conveniences and their rentals. I am convinced the promoters of this measure, in its future progress, will take care it shall interfere as little as possible even with the fancied comfort of proprietors. I add, that during the course of the proceedings on the Bill, and since its failure, I have observed a disposition

on the part of some who opposed it, to view it more favourably; and one who took a leading part in the opposition, has stated to me his own wish to have formed some amicable arrangement, but he found there were certain individuals who thought the injury they should sustain would be such as would not admit of remuneration; he could not desert them, and was therefore compelled, whatever might be his own inclination, to continue his opposition.

J. Solly, Esq. May I be permitted, as Chairman of the London Board of Directors of the proposed Railway, to thank your Lordship for the observations you have done us the honour to address to us. I am persuaded we shall never lose sight of them in the future conduct of our great undertaking. Our gratitude is likewise due to your Lordship and other Noble Peers, as well as to Honourable Members of the House of Commons, for their diligent and anxious attention during the sitting of the Committees on the Bill, and their close examination of the great mass of evidence it was necessary to adduce. For this voluntary addition to their other laborious duties, I would beg to assure them we feel sincerely and deeply grateful.

Lord Wharncliffe then recommended that, as many persons who would probably have been glad to join in these proceedings, had not been able to attend the meeting, they should be invited to add their signatures to the resolutions. He would sign them on behalf of the meeting.

Edmund Peel, Esq. M. P. Chairman of the Birmingham Board. I rise to move the thanks of this meeting to the Noble Lord who has done us the honour to take the Chair, and in particular for the valuable and most important observations he has addressed to us. Having taken an active part in the conduct of this undertaking, I feel some diffidence in trespassing upon your attention, lest I should be regarded as an interested party; but having for upwards of twenty-two years been engaged in commercial affairs, I must be permitted to say, that I do not think a measure was ever projected, calculated to produce such great and beneficial effects as that which has occasioned our present meeting. I can safely say, that the results of the Liverpool and Manchester Railway have far exceeded the expectation of the parties who embarked in it. Commercial men can safely appreciate the advantages of cheap, certain, and rapid means of communication. With regard to the apprehensions entertained — I am sure conscientiously — by certain Noble Lords, of injury to their estates from the Railway — time and reflection, I am convinced, will remove them; and the obstacles, which have for the present impeded our great undertaking, will at no distant period entirely disappear.

The *Earl of Denbigh* seconded Mr. Peel's motion.

The Resolution was then put and carried unanimously.

Lord Wharncliffe. It is not necessary for me to trouble you with my thanks on this occasion: all I can say is, that in the future progress of the measure I shall shew that I am very sensible of your kindness.

The foregoing Resolutions were subscribed by the following Members of the House of Peers, and of the House of Commons: —

Members of the House of Peers.

The Rt. Hon. Lord WHARNCLIFFE, *Chairman.*

Rt. Hon. Marquis of Sligo.
Rt. Hon. Earl of Aylesford.
——— Caledon.
——— Denbigh.
——— Glengall.
——— Gosford.
——— Howe.
——— Limerick.
Rt. Hon. Earl of Shannon.
——— Ranfurly.
Rt. Hon. Viscount Hood.
Rt. Hon. Lord Dinorben.
——— Lyttleton.
——— Mostyn.
——— Northwick.

Members of the House of Commons.

Sir G. Skipwith, Bart. *Chairman of the Committee.*
Arthur Atherley.
C. B. Baldwin.
Lord G. Bentinck.
John Browne.
C. Calvert.
O'Connor Don.
Sir J. M. Doyle.
T. S. Duncombe.
Wynne Ellis.
J. H. Foley.
James Foster.
B. Heywood.
Hon. John Henry Knox.
John James Knox.
F. Lawley.
N. P. Leader.
C. S. Lefevre.
John Morrison.
F. W. Mullins.
Lord Nugent.
Daniel O'Connell.
T. Paget.
E. Peel.
J. S. Penleaze.
G. R. Phillips.
E. T. Ruthven.
Sir E. D. Scott, Bart.
Charles Stewart.
Horace St. Paul.
Ralph Thicknesse.
Col. Torrens.
Charles Wynne.

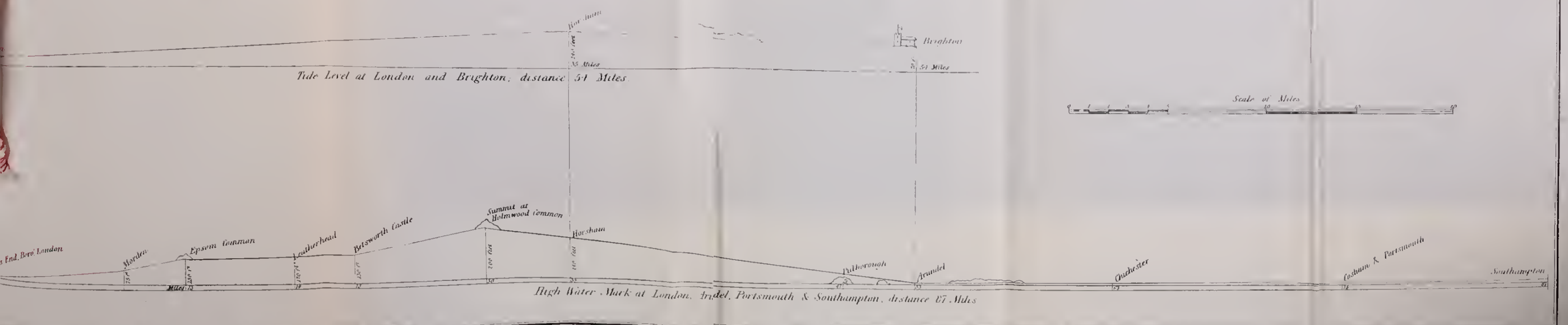
GRAND SOUTHERN RAILWAY,

Projected & Surveyed by

Nicholas Wilcox Cundy, Esqr.

Civil Engineer.

LONDON 1833.



In conclusion, then, it may be taken from the foregoing facts and evidence, that railroads will prove a great national benefit; and that locomotive engines are and can now be constructed at about one-fourth of their former expense, and to travel on the *levels* of the Greenwich railroad to Dover, the Western railroad to Reading and Newbury, the projected grand Southern railroad to Portsmouth, Shoreham, and Brighton, and the grand Northern railroad to York, safely, at the average speed of twenty-five to thirty miles an hour, without tunnels or steep inclined planes. A single engine is capable of propelling on such levels from 60 to 100 tons of goods and merchandise at the speed of twenty miles per hour, as will appear by the fact, that the engine called the *Fire Fly* travelled on the Liverpool railroad 22,000 *miles* in successive days, 155 *miles per day*, at the expense in fuel of a half-penny per mile.

The steepest part of the Liverpool railroad is at Rain Hill, where it rises about eight feet per mile; and from all the experiments that have been hitherto tried, a railroad, whose inclined plane exceeds ten to twelve feet rise per mile, destroys the objects for which commercial railroads are designed; viz. speed of travelling, and the transit of large cargoes of goods, grain, and merchandise, at a small expense: therefore, I am of opinion that railroads will not do for hilly countries, or cross roads; and roads of small traffic will be found inconvenient and too expensive to afford a fair return for capital.

The science of constructing steam-engines is now brought to maturity, so that an engine can be con-

structed to produce a certain power; and yet, every year, new wonders are produced, not only in England, but in France and America.

I have long since been of opinion that steam-engines will shortly be superseded by another class of engines, which will perform all that steam-engines have hitherto done, without the danger of fire or the bursting of boilers, and at one-fourth of the expense.

I have constructed *a philosophical engine*, designed to perform the duties of the steam-engine, without the aid of water, steam, or fire; which, I feel, ere long, will be brought into general use, and will give another powerful impetus to navigation and inland transit, by removing the stowage of coals and water, and the danger of fire, on board of ships, and the public may expect to see locomotive engines travelling on rail-roads, with a train of carriages, at the speed of from twenty to thirty miles an hour, without the aid of steam or any apparent cause.

What the world wants to complete its education are those sound principles of public economy, which contribute most to promote national and individual wealth and happiness, by removing the obstacles to internal communication and the march of useful knowledge, and establishing among us an interchange of commodities, according to the wants and the capabilities of each community.

Railroads may be constructed in five points out of London, to the great advantage of the public, like the ancient Roman roads; the Midland to Birmingham and Liverpool, the Northern to York, the Eastern to Dover, the Southern to Portsmouth, Shoreham, and Brighton, and the Western to Bath and Bristol, with

tributary branches from opulent towns and manufactories on each respective line of railroad. I venture to recommend these on public grounds only, no private party feelings or private interest should intervene or impede such important national designs.

When such extensive designs shall have been completed, the landowner, farmer, grazier, trader, manufacturer, and merchant will vie with each other, in the lasting benefit, splendour, and glory which such expanded views of science will send forth to the productive classes and the consumers of the production of the earth.

Extensive tracks of excellent land on each respective line of railroad will be brought into cultivation. The agricultural labourer and artisan will be called from the workhouse and prison to permanent and profitable labour; while the produce of the loom and the manufacturer will be called into extensive demand by the additional consumption that prosperity would give. Among the advantages that these railroads would give is the extension of agriculture; more than a million of acres of productive land would be brought into the foreground, and cultivated, through which the projected railroads would pass. Husbandry and labour would be extended; and the home growth of grain may be progressively made equal to home consumption; whereby the four or five millions per year, now expended in the purchase of foreign grain, may be expended in manual labour and cultivation at home.

These railroads would contribute towards the poor and county rates most essentially in every parish and county throughout which they pass; while manual labour would be extended to the advantage of all;

while they would confer the highest advantages to the merchant, and trader, and mariner. It would enable them to ship and transport their goods, wares, and merchandise with despatch and certainty, would remove the long complained of difficulty of valuable shipments or cargoes delayed by contrary winds in the north and southern channels, where large fleets, fleets of 500 sail of merchant ships, have been detained by contrary winds for six weeks, and sometimes three months, with perishable cargoes, viz. fish, fruits, butter, cheese, meat, eggs, corn, oils, tallow, &c., which, by the aid of the railroads, may be brought to the markets over land from the Humber, Boston, Lynn, and Portsmouth, and other of the outports, without the well-known danger of shipwreck and loss of human life in rounding the forelands of our northern and southern channels.

These exports and imports may be made by aid of the railroads at Shoreham and Portsmouth in the English Channel, and cannot be impeded by contrary winds, or the peril of war, — also from the ports of the Humber, Boston, Lynn, and Yarmouth, or Lowestoffe, on our northern coast, in the space of five hours, at the rate of about 5*s.* per ton. Thus many hundred valuable cargoes and human lives may be saved from shipwreck and capture.

These railroads will give advantages to His Majesty's government in the immediate and certain despatch of mails, couriers, troops, naval and military stores, and other munitions of war, both abroad and at home.

And, lastly, from the highly respectable classes of the foregoing evidence, given by landowners, farmers, graziers, salesmen, cornfactors, and others on the

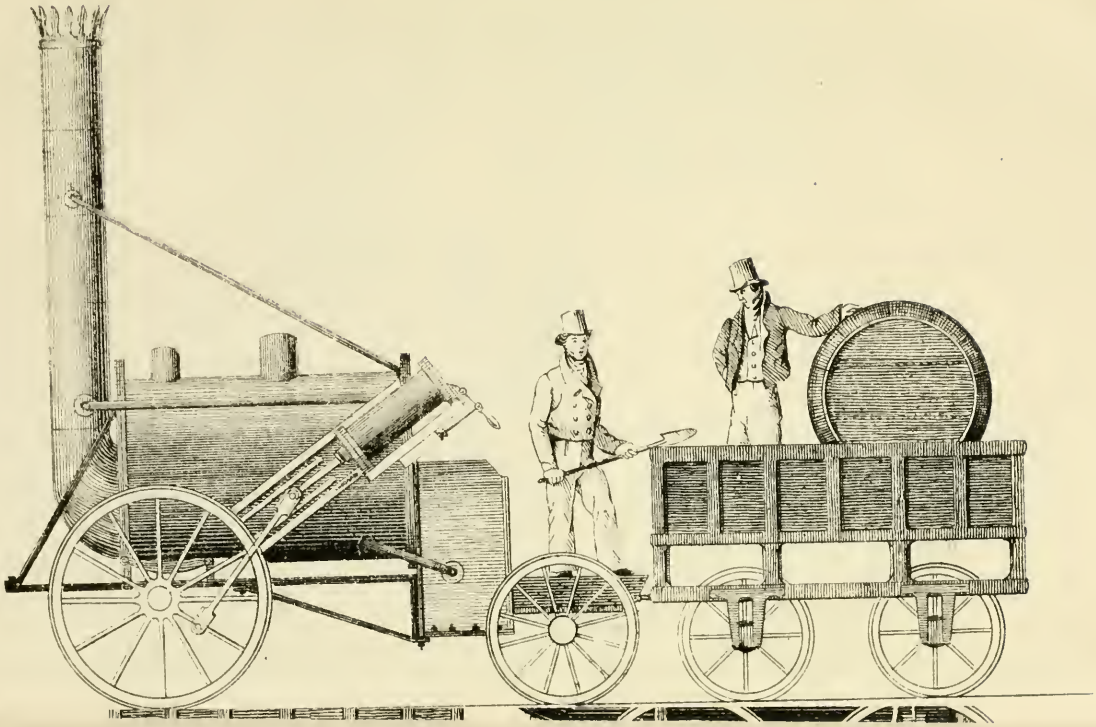
London and Birmingham railroad bill, in the last session of Parliament, decides, that no class of His Majesty's subjects are more interested than the land-owners. In constructing railroads, these railroads will reduce the present burthen upon the land, the poor and county rates, and extend manual labour and the consumption of the produce of the soil, and enable the cultivator and the productive classes to send forth their goods and wares, with great facility, at one third of the former expense, to the first markets in the world.

THE END.

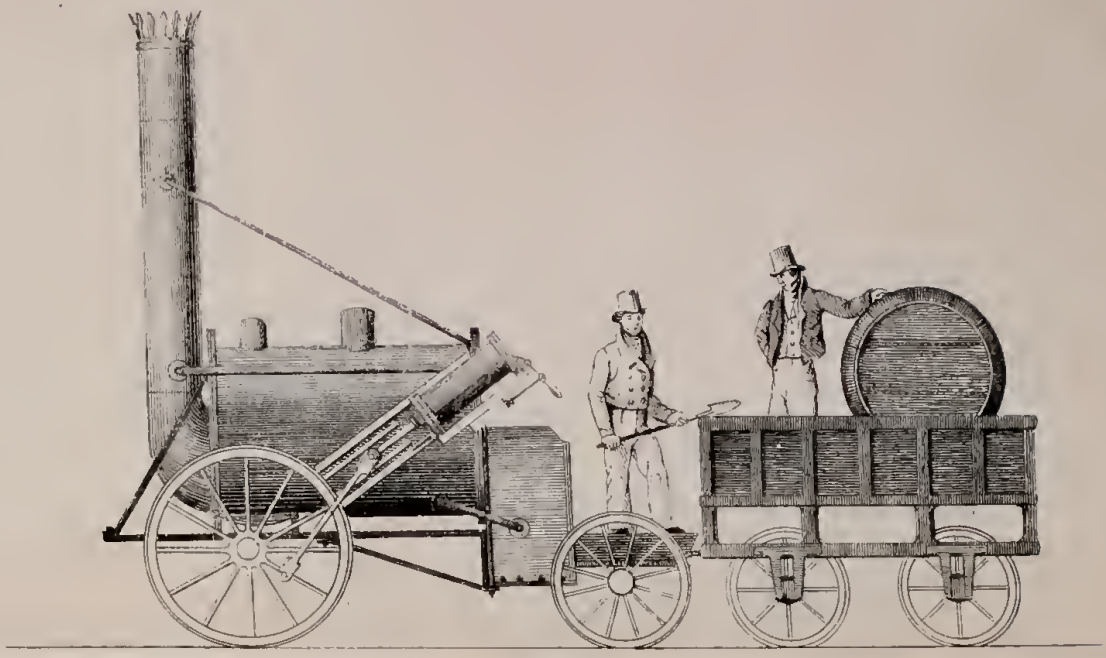
London:
Printed by A. Spottiswoode,
New-Street-Square.

THE LOCOMOTIVE STEAM ENGINES

Which competed for the Prize of £500. offered by the Directors of the Liverpool and Manchester Railway Comp^y_ drawn to a Scale ¼ inch to a foot.



Which competed for the Prize of £500 offered by the Directors of the Liverpool and Manchester Railway Compy — drawn to a Scale ½ inch to a foot

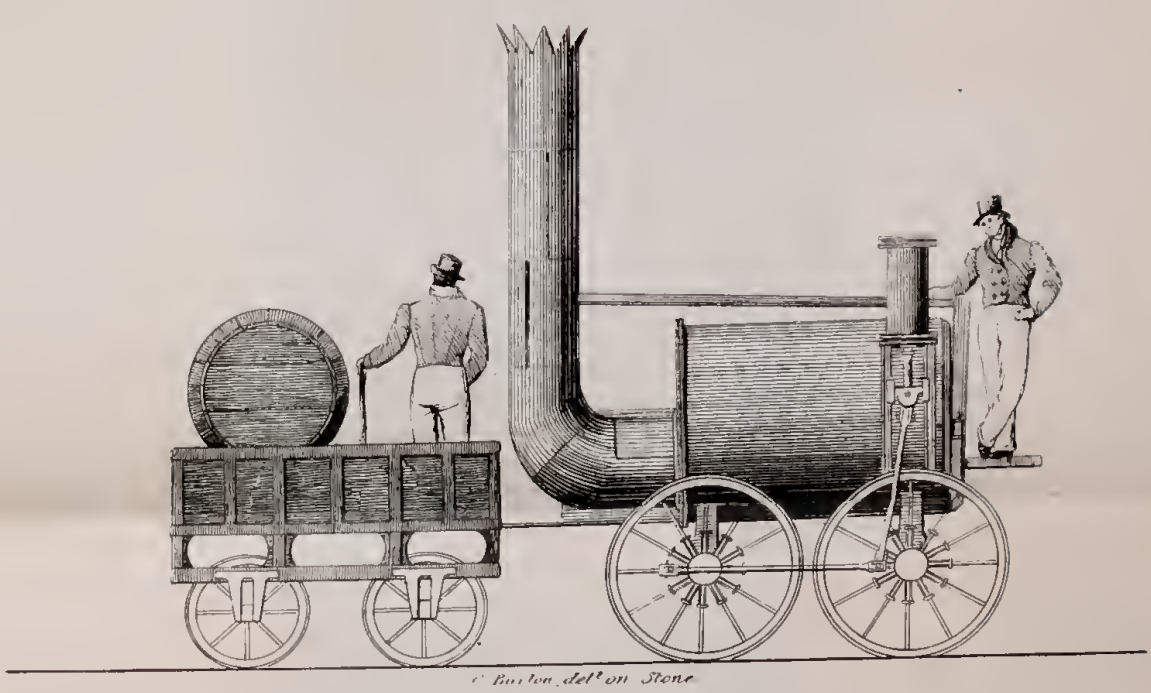


The **ROCKET** of Mr Robt Stephenson of Newcastle

Which drawing a load equivalent to three times its weight travelled at the rate of 12½ miles an hour, & with a carriage & passengers at the rate of 24 miles. Cost per mile for fuel about three-halfpence

The **NOVELTY** of Messrs Braithwaite & Erricsson of London

Which drawing a load equivalent to three times its weight, travelled at the rate of 29¾ miles an hour & with a Carriage & Passengers at the rate of 32 miles. Cost per mile for fuel about one halfpenny



C Burton del[t] on Stone

The **SANS PAREIL** of Mr Hackworth of Darlington.

Which drawing a load equivalent to three times it's weight, travelled at the rate of 19¼ miles an hour — Cost for fuel per mile about two pence

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